

# Graduate Handbook

## Department of Physics & Astronomy

### University of Alabama

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# I. INTRODUCTION

The Department offers both the Ph.D. degree in physics and the M.S. degree in physics. The M.S. degree includes both a thesis option (Plan I) and a non-thesis option (Plan II). Both the Ph.D. and the M.S. degrees in physics are offered with specialization in astronomy. The departmental requirements for these degrees are outlined in this manual and in the Graduate Catalog. Checklists, [advising worksheets](#), and the various forms needed for the completion of a degree, can be found in the [Academics area of the departmental web site, physics.ua.edu](#). Students are advised to make [personal](#) copies of completed forms before submitting them. Students are subject to the general rules and regulations of the Graduate School as given in the Graduate Catalog as well as the specific rules and regulations of the Department of Physics and Astronomy.

Each student has an individual responsibility to know and understand the rules and regulations of the Graduate School and of the Department and the requirements for the degree that he or she is pursuing. Students are encouraged to consult with their faculty advisors or the department chairperson if these requirements are not clearly understood. Much valuable and up-to-date information can be found on the Graduate School website, [graduate.ua.edu](#). You should also be familiar with the departmental site, [physics.ua.edu](#). Each graduate student will be assigned an academic advisor when the student initially enrolls in the Department. After a student has chosen a research advisor (as described elsewhere in this manual), then the research advisor will replace the academic advisor as the student's faculty advisor (unless they are the same).

## II. ACADEMIC POLICIES AND REQUIREMENTS

### A. SCHOLASTIC REQUIREMENTS

**Masters' vs. Ph.D. programs:** All students who enter our graduate program without a prior Masters' degree will enroll in our Master's program upon arrival. Entry into our Ph.D. program is gained by passing the Qualifier Exam (see below). The Graduate Advising Committee will assess whether individual international degrees are equivalent to our Master's degree.

**Academic Advising:** Before registering for classes each semester, students must discuss their academic schedules with an advisor, to help insure that appropriate classes are taken in a timely way (as well as confirm that PH597 or AY597 is enrolled in each semester and, if relevant, insure the appropriate research course is taken). Students must obtain an advisor's signature on the departmental pre-registration form before registering for classes each semester. Students must also obtain an advisor's signature on the departmental drop/add form before dropping or adding courses. These forms are available on the departmental web site.

**Minimum GPA:** According to the Graduate Catalog, a student must maintain a cumulative average of not less than "B" (3.0 on a 4.0 scale) in the graduate courses undertaken at The University of Alabama, and at least 75% of these hours must be completed with grades of not less than "B". Courses in which a student has made a grade of "P" or "S" are not considered in evaluations of academic standing. Students who do not meet these requirements (after having earned 12 semester hours of credit) are placed on academic warning. Warning status must be removed by raising the overall grade point average to "B" or better during the next 12 hours of graduate course work. *Students may not hold an assistantship while on academic warning.* Students who are conditionally admitted must maintain a "B" average during their first 12 hours. (PH597, AY597, PH598, and

PH698 should be taken only as pass/fail and cannot be used in computing GPA.) Failure to remove either a warning or conditional status within the prescribed time will result in the student being dropped from the graduate program.

## **B. ENROLLMENT POLICIES FOR GRADUATE TEACHING/RESEARCH ASSISTANTS**

The following is a summary of the current graduate school policies regarding course loads for all teaching assistants and research assistants.

Graduate assistants must be full-time graduate students during all periods in which they receive financial assistance from the University or associated agencies. Depending upon their assistantship obligations, graduate assistants should normally enroll for 6 to 12 hours of graduate course work. The Graduate School imposes the following enrollment limitations:

<u>TA/RA AWARD</u>	<u>MIN-MAX GRADUATE ENROLLMENT</u>
0.25 FTE	9-12 semester hours
0.50 FTE	6-9 semester hours*
0.75 FTE	3-6 semester hours
1.00 FTE	1-3 semester hours

\* PH/AY assistants may take 10 hours if 1 hour is 597 (seminar).

In addition it should be noted that Immigration Regulations limit international students to a maximum of 20 hours per week of employment during the academic year, including any combinations of on- and off-campus positions.

A fellowship, as a non-service award, is outside the scope of these policies. Fellows, by the terms of their appointments, are required to undertake full-time graduate study.

Enrollment during the summer is not mandatory for graduate teaching and research assistants.

## **C. POLICIES ON FINANCIAL SUPPORT**

### **1. *Teaching Assistantships***

A new graduate student who has been awarded a teaching assistantship can normally expect to have the TA renewed as long as s/he is making satisfactory progress towards a degree and fulfilling his/her assigned duties in an acceptable manner, as stipulated by the student's advisor and the department chairperson, and as long as funds are available. There are time limits, however, on the total number of years that a student may hold a TA. A student working toward a M.S. degree will normally be expected to complete the degree requirements within two years, and financial support will not routinely continue beyond that period. In special cases, upon petition and approval of the department chairperson, financial support may be continued for up to three years.

Special note about "conditional" admissions: when an applicant's entrance exam or GPA score is not up to University minimum requirements, admission is conditional. There are two important consequences of this. First, if you do not maintain a graduate GPA of 3.0 or better while in conditional status, you will lose your assistantship. Second, if your GPA is below 3.0 at the end of the term in which you complete your 12th credit hour, you will be dismissed from the program.

These two policies are applied rigorously by the Graduate School, so you are urged to apply yourself diligently to your coursework your first year if you are admitted conditionally.

Financial support for Ph.D. students may be withdrawn if they do not pass the Qualifying Exam by the end of their second year in residence and if they do not pass the Preliminary Exam by the end of their fourth year in residence. A maximum of six years of TA support is allowed for Ph.D. students. This does *not* mean, however, that students are automatically guaranteed six years of support. Students are encouraged to graduate in a timely manner, and support will not be continued if it is decided that the student is not making adequate progress. Students who are required to pass the International Teaching Assistant Program exam must do so by the end of their **second semester** in order to receive continued TA support.

## **2. *Research Assistantships***

Students are encouraged to start research as soon as practical, by discussing opportunities for research with faculty in their area of interest. Many students are supported on research assistantships after their first or second year in residence. This enables a student to focus on research, and make speedier progress toward his or her degree. RA's are generally funded by external grants obtained by faculty members. The amount of the RA stipend varies somewhat, but is usually at least as much as a TA stipend. Continuation of a research assistantship is contingent on the student's satisfactory progress, as well as availability of funds, which may change from year to year. When a student's research assistantship is not renewed, he or she will be considered for a teaching assistantship, using the criteria of length of time in the graduate program, progress toward degree, and availability of TA funds.

## **3. *Fellowships***

The Graduate School has several fellowship programs for which students may apply. Graduate Council Regular Fellowships are primarily awarded to exceptional incoming students. Graduate Council Research Fellowships are for students doing research that is funded externally, or may lead to external funding. Dissertation Fellowships are for students in the final stages of the research leading to their dissertation. Physics and Astronomy students have been rather successful in receiving these fellowships, especially the latter two, which carry nice stipends and a certain amount of prestige. Students do not apply directly for these fellowships, but must be nominated by the department. Let your advisor know if you are interested. Check the Graduate School website for more information.

## **4. *Summer Support***

Summer support is guaranteed by the department for the first summer of a student's graduate career. **For international students, this support is contingent upon passing the ITAP exam by the end of their second semester.** The support may be in the form of a RA or a TA. In subsequent years, support is not guaranteed, but almost all students are supported on some sort of assistantship or fellowship. Students interested in summer RA support should approach faculty in their area of interest to see if support is available. Students do not need to register for courses during the summer, and are encouraged to spend as much time on research as possible.

## 5. *Jobs outside the Department*

Teaching and research assistants who hold a 0.5 FTE or greater appointment are not allowed to hold additional employment outside the Department, with the exception of tutoring, without special permission from the department chairperson. The Department's policy is that time not taken up by assistantship duties should be devoted to course work, research, and other degree requirements. Since tutoring aids graduate students in learning the fundamentals of their discipline, a maximum of 5 hours of tutoring per week is allowed. Tutoring students for pay in a course in which you are assigned is not allowed.

### D. Time Limits

**Master's:** All requirements for the master's degree must be completed during the six years (18 fall, spring, and summer semesters) immediately preceding the date on which the degree is to be awarded.

**Ph.D.:** All requirements for the doctoral degree must be completed within the seven-year period (21 fall, spring, and summer semesters) following admission to the doctoral program. A single one semester extension may be granted in compelling extenuating circumstances. If the time limit is exceeded, the student will need to reapply to the Ph.D. program and, upon readmission, retake classes that were taken more than 7 years previously.

## III. REQUIREMENTS FOR THE DEGREE OF Ph.D.

### A. COURSE REQUIREMENTS

#### 1. *Physics*

A total of 48 hours of formal course work is required (in addition to 24 hours of dissertation research, PH 699). An “*Outline of Ph.D. Program (Plan of Study)*” form must be submitted to the Graduate School by the semester in which 30 hours have been earned. All students must take the following six core physics courses:

#### **Core Courses:**

- PH 501 - Classical Dynamics
- PH 531/532 - Electromagnetic Theory
- PH 541/542 - Quantum Mechanics
- PH 571 – Statistical Physics

The completion of any of the above courses (or the equivalent as approved by the department chairperson) with a grade of “B” (3.0/4.0) or better prior to enrolling as a graduate student in this department will constitute fulfillment of the requirement for that course. (See Section V.)

**Physics Seminar:** All full-time physics students are required to enroll for one hour of PH 597 (Physics Seminar) each semester in residence. Seminar requirements include attending at least 10 specialty seminars (e.g., MINT or Theory) and/or departmental colloquia. First-year physics students must attend a minimum of one MINT and one Theory seminar. For students in the second year and beyond, the division among seminars and departmental colloquia will be determined by the student's advisor in consultation with the student. Students in the second year and beyond must also

make one presentation each semester (astronomy students give presentations starting their first semester). Grading for PH 597 is pass/fail.

**Dissertation research:** Students are required to earn at least 24 hours of dissertation research (PH 699). However, a student cannot gain credit for Dissertation Research (PH 699) before s/he passes the Prelim Exam. Note that, once initiated, enrollment in PH 699 must be continuous until the Ph.D. is awarded.

**Other course requirements:** Physics students must take an additional 18 hours of graduate course work as determined by the student's advisor in consultation with the student. The remaining 12 hours of the 48-hour course requirement can be chosen by the student. A maximum of six hours of the 48-hour requirement can come from a combination of PH 597, PH 598 and PH 698 (although students may will normally take more than six hours of these courses, particularly PH 597). A maximum of 12 of the 48 hours may be taken outside the department. These courses, which must be at the graduate level and relevant to their research, should be from the following departments: Mathematics, Computer Science, Chemistry, Biology, Geology, and departments within the College of Engineering.

## 2. *Physics with astronomy specialization*

A total of 48 hours of formal course work is required (in addition to 24 hours of dissertation research, PH 699). All students must take the following six core physics courses:

### **Core Courses:**

- PH 501 - Classical Dynamics
- PH 531/532 - Electromagnetic Theory
- PH 541/542 - Quantum Mechanics
- PH 571 – Statistical Physics

**Astronomy course requirements:** At least 15 hours must be from the following list, with at least one at the 600 level:

- AY 501 - Celestial Mechanics & Astrodynamics
- AY 521 - Theoretical Astrophysics
- AY 533 - Observational Techniques
- AY 550 - Stars and Stellar Evolution
- AY 570 - Galaxy and Interstellar Medium
- AY 620 - Extragalactic Astronomy
- AY 640 - Radiation Processes in Astrophysics
- AY 650 - Astronomy Special Topics (only 3 hrs can count toward the 15-hr AY requirement)
- AY 660 - Astrophysical Plasmas & Magnetodynamics

The completion of any of the previously listed astronomy courses or core physics courses (or the equivalent as approved by the department chairperson) with a grade of “B” (3.0/4.0) or better prior to enrolling as a graduate student in this department will constitute fulfillment of the requirement for that course. (See Section V.)

**Astronomy seminar:** All full-time astronomy students must register for one hour of AY 597 (Astronomy Seminar) each semester in residence. Seminar requirements include attending

weekly astronomy seminars, departmental colloquia, and making presentations, as specified by the student's advisor.

**Dissertation research:** Students are required to earn at least 24 hours of dissertation research (PH 699). However, a student cannot gain credit for Dissertation Research (PH 699) before s/he passes the Prelim Exam. Note that, once initiated, enrollment in PH 699 must be continuous until the Ph.D. is awarded.

**Additional course requirements:** Three additional hours will be determined by the advisor in consultation with the student, and the remaining courses can be chosen by the student. A maximum of six of the required 48 hours of formal course work may include a combination of AY 597, PH 598, and PH 698 (although students will normally take more than six hours of these courses, particularly AY 597). A maximum of 12 of the 48 hours may be taken outside the department. These courses, which must be at the graduate level and relevant to their research, should be from the following departments: Mathematics, Computer Science, Chemistry, Biology, Geology, and departments within the College of Engineering.

## **B. QUALIFYING AND PRELIMINARY EXAMINATIONS**

There are two separate exams that a prospective Ph.D. candidate must pass. The first of these, the Qualifying Exam, is given early in the student's career and covers primarily advanced undergraduate physics; **passing the Qualifying Exam is a requirement for entering the Ph.D. program.** The second exam, the Preliminary Exam, is given before the dissertation research is begun and is more closely related to the student's research area; passage of this exam formally admits one to candidacy for the Ph.D.

### **1. Qualifying Examination**

The Qualifying Exam is given each January. Although there is no limit on the number of times a student may take the exam, **financial support may be withdrawn if a student does not pass the exam by the end of the student's second year.** All graduate students are required to take the Qualifying Exam each year until they pass it. As an alternative to passing the Qualifying Exam, students can submit a physics GRE score of at least 60th percentile. The GRE may also be taken an unlimited number of times.

The Qualifying Exam is a written test consisting of three parts covering four areas of undergraduate Physics: Part I. Electricity & Magnetism; Part II. Quantum Mechanics; Part III: Classical Mechanics (~75%) & Thermal Physics (~25%). Each part must be passed separately with a score of at least 70%. Passing an individual part means it does not need to be repeated in subsequent tries (if subsequent tries are necessary). Students can appeal in borderline cases (for example, if a student make 65% or more). The committee will review appeals and make final decisions.

### **2. Preliminary Examination**

The Preliminary Exam focuses on the student's area of specialization, and may include areas of graduate-level physics related to the research. The student in consultation with his/her research advisor chooses a committee consisting of four faculty members. The advisor will not be a member of the committee but will be invited to observe the examination. The department chairperson must

approve the committee. A form to be used in selecting the committee is **provided on the department website. No more than one committee member can be from outside the department.** Students without a research advisor will not be allowed to take the exam.

The exam should be taken as early as possible once the student has finished the appropriate graduate coursework and has begun actual dissertation research (**normally before the end of a student's 7<sup>th</sup> semester**). The exam consists of two parts: a written research plan and an oral examination. The written research plan (up to 2000 words) developed with the research advisor must be submitted to the committee members two weeks before the oral exam. The research plan should include a description of the problem to be addressed, a literature survey, the approach that will be undertaken to tackle the problem, and a discussion of expected results. The oral examination will consist of a forty-minute presentation of the research plan followed by questions from the committee on the research plan and the application of graduate level coursework to the proposed research. The decision to pass or fail will be based on these two criteria: 1) the student's knowledge of graduate-level physics and 2) the feasibility of the proposed research plan.

The Preliminary Exam chairperson will notify the department chairperson in writing of the committee decision after the student attempts the exam. After the student has passed the exam, the Preliminary Exam Committee will sign the Application for Admission to Candidacy form. Only two attempts of the Preliminary Exam are permitted. Financial support may be withdrawn if the student does not pass the Preliminary Exam by the end of the student's fourth year in residence.

### **C. MASTER'S DEGREE ENROUTE TO THE Ph.D.**

Once a student has successfully passed the Preliminary Exam, s/he has automatically satisfied the requirements for the Plan II Master's Degree. This is because the Preliminary Exam can be substituted for the comprehensive master's exam. In order to receive the M.S. degree, the student need only submit three forms (**an application for Admission to Candidacy for the Master's, an Application for Degree, and the Master's Comprehensive Exam form**).

### **D. RESEARCH AND DISSERTATION**

#### ***1. Selecting a research area and a research advisor***

The selection of a research area and advisor should be made as soon as possible after the student has passed the Qualifying Examination. **A student cannot gain credit for Dissertation Research (PH 699) before s/he passes the Preliminary Exam.** The student should first interview several faculty members whose research may be of interest to the student, and the faculty members will describe potential research projects. The selection of a research area and a research advisor will then be made by agreement between the student and the advisor. As soon as the selection is made, both the student and the advisor must notify the department chairperson in writing. If a student and research advisor mutually agree to end their relationship, the student and advisor must both notify the department chairperson in writing of this action. The student must then begin the selection process again. The Department requires that all students doing research toward a degree be supervised by a research advisor approved by the Department. The student must keep his/her advisor fully **and regularly** informed of the progress of his/her research. Failure to do so could result in the dissertation not being approved.

## ***2. The dissertation committee***

After selection of a research advisor and research area and after passing the Preliminary Examination, the student, in consultation with his/her advisor and the department chairperson, will form a Dissertation Committee. The committee will consist of five members of the Graduate Faculty, including the research advisor as committee chairperson, three other faculty members from the Department of Physics and Astronomy, and one faculty member of another department. (The external committee member may be from another institution if prior approval is obtained from the Dean of the Graduate School.) **The chair must be a full member of the Graduate Faculty.** Students doing theoretical (experimental) dissertations are advised to have at least one faculty member on the committee who is an experimentalist (theorist). At least one departmental member of the committee should be from an area outside the student's major research concentration. **If the research advisor is not a regular member of the department (either external or adjunct), a regular member of the department must serve as co-chair. An advisor from outside the department would also serve as the external member of the committee.** A form to use in selecting the committee is available on the department website. **The student is required to meet with the Dissertation Committee at least once a year for assistance in monitoring and guiding the student's research.**

## ***3. Final version of the dissertation***

A final version of the dissertation will be given to each of the five members of the Dissertation Committee at least two weeks before the oral defense. The student is responsible for all aspects of the production of the dissertation, including the preparation, typing, reproduction, dissemination to the committee members, and all costs involved. Departmental resources cannot be utilized for the production of the dissertation.

Please submit a clean, unbound copy of your completed dissertation to the office after your defense, for our permanent records.

## ***4. Oral examination***

A final oral examination must be passed after completion of the dissertation. This examination follows a public presentation by the candidate on the results of his or her research. The examination will be primarily on the candidate's research work as embodied in the dissertation, but it may also encompass the complete program for the degree. The examining committee will be the Dissertation Committee previously described.

# **IV. M.S. DEGREE**

## **A. PLAN I M.S. IN PHYSICS (THESIS OPTION)**

### ***1. Course requirements***

A total of 24 hours of formal course work is required (in addition to six hours of research).

## **Required courses in physics:**

PH 501 - Classical Dynamics  
PH 531/532 - Electromagnetic Theory  
PH 541/542 - Quantum Mechanics  
PH 599 - Thesis Research (6 hours)

**Other required courses:** Full-time physics students must register for one hour of PH 597 (Physics Seminar) each semester in residence. Seminar requirements are the same as for the Ph.D. degree. Nine hours of additional graduate level course work, which must be approved by the Department, are required in order to meet the minimum of 24 hours. PH 597 and PH 598 cannot count toward the 24-hour requirement. Six of these hours may be taken outside the Department.

### ***2. Selecting a research area and a research advisor***

A student should first interview several faculty members whose research may be of interest to the student, and the faculty members will describe potential research projects. The selection of a research area and a research advisor will then be made by agreement between the student and the advisor. As soon as the selection is made, both the student and the advisor should notify the department chairperson of the decision in writing. The selection should be done before or during the second semester of graduate study. The Department chairperson must also be notified in writing of any change of research advisor.

### ***3. The thesis committee***

After selection of a research advisor and research area, the student, in consultation with his/her advisor and department chairperson, will form a Thesis Committee. The committee will consist of at least three members, including the research advisor as committee chairperson, one other faculty member from the Department of Physics and Astronomy, and one faculty member from another department. (The external committee member may be from another institution if prior approval is obtained from the Graduate Dean.) A form to use in selecting the committee is available on the department web site.

### ***4. The final version of the thesis***

A final version of the thesis will be given to each of the members of the Thesis Committee at least two weeks before the oral defense. The student is expected to be responsible for all aspects of the production of the thesis, including the preparation, typing, reproduction, dissemination to the committee members, and all costs involved. Departmental resources cannot be utilized for the production of the thesis.

### ***5. Oral examination***

A final oral examination must be passed after completion of the thesis. The examination will be both a comprehensive examination on the masters degree program as well as an examination of the candidate's research work as embodied in the thesis. The examining committee will be the

Thesis Committee previously described. The student may take the oral examination no more than twice.

## **B. PLAN I M.S. IN PHYSICS WITH ASTRONOMY SPECIALIZATION (THESIS OPTION)**

### **1. Course requirements**

A total of 24 hours of formal graduate course work is required (in addition to six hours of thesis research).

#### **Physics course requirements:**

PH 501 - Classical Dynamics  
PH 531 - Electromagnetic Theory  
PH 541 - Quantum Mechanics  
PH 599 - Thesis Research (6 hours)

#### **Astronomy course requirements:** At least three of the following:

AY 501 - Celestial Mechanics and Astrodynamics  
AY 521 - Theoretical Astrophysics  
AY 533 - Observational Techniques  
AY 550 - Stars and Stellar Evolution  
AY 570 - Galaxy and Interstellar Medium  
AY 620 - Extragalactic Astronomy

In addition to the aforementioned physics and astronomy courses, full-time astronomy students should enroll for AY 597 (one hour of seminar) each semester in residence. PH 597 and PH 598 cannot count toward the 24-hour course requirement.

Six hours of additional graduate level course work, which must be approved by the Department, are required.

### **2. Research and thesis**

The general rules concerning research and the thesis that apply to the Plan I M.S. in physics also apply to the Plan I M.S. in physics with astronomy specialization.

## **C. PLAN II M.S. IN PHYSICS (NON-THESIS OPTION)**

### **1. Course requirements**

A total of 30 hours of formal course work is required. The course requirement is the same as for the Plan I M.S. degree except that in place of PH 599 (Thesis Research) the student will take two of the following courses:

PH 551 - Atomic and Molecular Physics  
PH 561 - Nuclear and Elementary Particle Physics  
PH 571 – Statistical Physics  
PH 581 - Solid State Physics

## **2. Oral examination**

A comprehensive oral examination on the course content of the Plan II M.S. program must be passed during the last semester of study. The committee will consist of at least three members of the department to be chosen by the department chairperson in consultation with the student. The student may take the oral examination no more than twice. Note: A student en route to a doctoral degree may substitute the Preliminary Exam for this M.S. oral exam.

## **D. PLAN II M.S. IN PHYSICS WITH ASTRONOMY SPECIALIZATION (NON-THESIS OPTION)**

### **1. Course requirements**

A total of 30 hours of formal graduate course work is required. The course requirements are the same as for the Plan I M.S. in physics with astronomy specialization except that in place of PH 599 (Thesis Research) the student will take PH 532 (Electromagnetic Theory) and PH 542 (Quantum Mechanics).

### **2. Oral examination**

The student must pass an oral examination as described under the Plan II M.S. in physics described in part C.2 above.

## **V. TRANSFER CREDIT**

Students are allowed to apply for transfer of graduate credit earned at another institution. In order for a course to be considered for transfer credit, the student must have earned a minimum grade of “B” on the course. In addition, the student must have achieved an overall average of “B” or better on all courses attempted at the institution from which transfer credit is being requested. The Graduate School must have an official transcript of the credit involved. Up to 1/2 of the required course work for a Ph.D. or M.S. degree is allowed to be transferred, with the approval of the department and the dean of the Graduate School. All credit toward the master's degree must have been earned during the six years immediately preceding the date on which the degree is awarded. All credit toward the Ph.D. degree must have been earned during the six-year period preceding admission to the doctoral program. A form is available on the department website for submission to the Graduate School in applying for transfer credit.

In some cases, the Graduate School will be unable to grant transfer credit based on the information they have, and may suggest the student submit his or her transcripts to World Education Services ([www.wes.com](http://www.wes.com)). Upon the recommendation of the department's Graduate Advising Committee, the department will cover the \$125 fee for the WES services.