



EMORY

LANEY
GRADUATE
SCHOOL

Department
of Physics

Guidelines and Program Information 2021-2022

Math and Science Building, Emory Atlanta campus



INTRODUCTION

This handbook outlines program policies and procedures for Emory Physics Graduate Program scholars. Scholars should also familiarize themselves with the policies and procedures of the Laney Graduate School (LGS) via their LGS handbook: <https://gs.emory.edu/handbook/>. Continuing scholars agree to be bound by the rules and requirements of both handbooks. While we strive to keep the Physics graduate handbook complete and updated, the program administration may clarify or change policies as needed, with the approval of the LGS Executive Council. All changes will be announced ahead of time and reflected in the copy of the handbook available on the department website. If there are major changes to any policies during the tenure of this handbook that would affect a student's academic progress, scholars who entered the program under a previous handbook will still be held to the handbook in place when they started at Emory.

If you have questions about the handbook, your first point of contact should be the Graduate Program Coordinator. All forms referenced in this handbook are available from the Graduate Program Coordinator and on our website.

GRADUATE PROGRAM ADMINISTRATION

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HOW TO USE THIS HANDBOOK

The graduate handbook is designed to allow graduate scholars to inform themselves about the policies and procedures in place for their program of study. The following description of the design of this resource is intended to help you navigate this handbook:

- Section headers appear in light blue with white text and appear in the document navigation
- Forms and information available on the main website appear as blue links
- Dates and deadlines appear in red

In making the most of this resource, the following information may be helpful.

1. The handbook in place in the year in which you enter the program is the handbook of record for your entire graduate career. In the event that there is a substantial change to program policy, you will generally be offered a choice of adopting the new policy or continuing to follow the handbook for your year of entry. It is important that you read and understand the handbook in place during your year of entry. Please be aware that when seeking advice from other students, they may be bound by a different handbook; therefore take this information into consideration.
2. Your program handbook should be understood to work in concert with the Laney Graduate School handbook and with university-level policies. Unless this handbook outlines specific customization of an LGS policy, you should follow the rules of the LGS handbook. Where an LGS-level policy is not addressed in this handbook, you should follow the LGS policy. Examples of policies include parental accommodation, leaves of absence, off-ramp terminal M.S. degree, grading and incompletes, etc. It is important to read this handbook and the LGS handbook in full after which you can utilize them as reference documents.
3. This handbook is a living document – its meaning and effectiveness may shift according to the people who put its language into practice. You may encounter a unique situation that is not covered here or, perhaps, your own interpretation of handbook language at some point in your career will be ambiguous. In this case, you have several paths available to you:
 - a. In the case of ambiguity in regard to a program requirement, consult with your advisor. If your advisor cannot answer your question, you may consult any member of the graduate physics team for clarification. If you and your advisor cannot come to an agreement on how to interpret a requirement, you should reach out to the Director of Graduate Studies for clarification and mediation. In cases where this presents a conflict of interest, you should reach out to the Assistant Dean of Student Affairs in Laney Graduate School.
 - b. Graduate scholars may petition the graduate committee to customize their path through the program where unique circumstances require a deviation. As an example, students may petition to complete a core requirement after the handbook deadline in the case of a significant competing academic requirement or personal

circumstance. Requests should be written by the student and addressed as a letter to the Director of Graduate Studies. The P.I. may cosign the letter or submit an additional letter in support of the petition, but this is not required.

- c. In an instance where you believe that you understand a requirement but disagree with its meaning and/or the way it is applied, you may petition the graduate committee to address your concerns. Another option is to reach out to the [University Ombuds Office](#) as this office is charged with “a responsibility to address concerns about policies and procedures, including potential future issues, and provide recommendations for responsibly addressing them.”

GOALS FOR GRADUATE STUDENTS

The James T. Laney School of Graduate Studies is committed to graduate education that provides students with deep and broad expertise in their chosen fields, creativity to cross-discipline boundaries, courage to challenge convention, and confidence to ask unexpected questions and articulate bold new perspectives.

Student scholars in the Emory Physics Graduate Program will receive training and expertise commensurate with their field of research. More broadly, graduates will be able to:

- Pose a research question and formulate an investigative approach using current research methods in theoretical or experimental physics.
- Conduct and communicate independent, original research.
- Critically evaluate the research literature in physics.
- Communicate concepts and procedures effectively to peers, scholars, the scientific community, the lay public, and granting agencies.
- Apply their education to careers and, more broadly, to challenges and opportunities in the world around them.

RESEARCH AREAS AT EMORY

The research in the physics graduate program is focused on four principal areas, which are currently among the most active in the basic and applied physical sciences. Both experimental and theoretical research is conducted in the program in each of these areas.

Biophysics investigates problems at the interface of physical and life sciences. Molecular biophysics addresses the contributions of molecular structure and dynamics to biological function. Spectroscopic investigations of catalysis in metalloenzymes use steady-state and time-resolved techniques of electron paramagnetic resonance and transient optical absorption spectroscopies. Experimental approaches to elucidating cellular and biomolecular processes use high-sensitivity fluorescence methods, including fluorescence correlation spectroscopy. Single molecule fluorescence resonance energy transfer, single molecule particle tracking, as well as magnetic tweezers techniques are used to study nucleic acid structures and protein-DNA interactions. Theoretical statistical physics is used to understand how biological systems, from molecular circuits and single neurons to brains and populations, learn from their surrounding environment and respond to it. Numerical and analytic models are used to analyze biological populations to predict their future evolution.

Condensed Matter Physics and Optics investigate nanoscale systems where surfaces, interfaces, and confinement effects result in new physical phenomena. Such phenomena are expected to be important for the development of future information technology, novel sensors, and artificial intelligence. Studies include nanoscale magnetic (spintronic) devices, nano-optical systems and devices, plasmonics, two-dimensional materials, effects of topology on the electronic and magnetic properties of nanostructures, strongly correlated electronic materials, complex magnetic and electronic systems. Our research in optics and light-matter interactions at the nanoscale (nanophotonics) focuses on the influence of dimensionality, structure, composition, and nonlinearities on the electromagnetic phenomena. Our investigations of the roles of geometry and topology in reduced dimensions, e.g. in atomically thin 2D materials, are aimed to achieve the ability to control and manipulate charge carriers and their degrees of freedom such charge, spin, and pseudo-spin, especially in the context of quantum optics and strong light-matter interactions.

Soft Matter Physics research addresses the properties of materials that display both fluid and solid behavior ("complex fluids"). It examines the connection between microscopic and macroscopic properties. Microscopy techniques are used to study phase transitions in colloidal systems. Light scattering, rheology, thermal imaging, and microfluidics are used to investigate fluid dynamics and multi-phase flow. Experiments on polymers concern the glass transition, structural relaxation, miscibility, and nanoscale interactions in polymers that affect dynamics at and near interfaces. Nonequilibrium properties of glasses are studied from molecular to microscopic to macroscopic scales, with jamming and granular studies even used to mimic natural phenomena at geophysical scales.

Statistical and Computational Physics addresses both equilibrium and nonequilibrium properties of condensed matter. Theoretical and computational work investigates the emergence of complex collective behavior, pattern formation under far from equilibrium conditions, the glass transition,

fracture propagation, dynamical synchronization in complex networks, self-organized criticality, optimization, nonequilibrium growth phenomena, fractals, and kinetic roughening of surfaces and interfaces. Theoretical and computational methods are also being applied to problems in biological physics, including vascularization, dynamics of molecular motors, morphogenesis, and intracellular active transport and jamming.

Physics researchers benefit from close interdisciplinary interactions and collaborative opportunities with other graduate programs and research centers at Emory University. Among the closely collaborating units are the graduate program in Mathematics and Computer Science, which is also located in the Math and Science Center Building, and the graduate program of Chemistry and the Emerson Center for Scientific Computation located across the street. Researchers at Emory's renowned School of Medicine are a short walk away.

For more information, explore the research websites of each faculty member:

<http://www.physics.emory.edu/home/people/>

OVERVIEW OF PHD REQUIREMENTS

Course Requirements

The Physics PhD degree requires the completion of 8 courses (4 core courses + 4 electives).

Core courses (to be taken during your first two terms in your first year)

- PHYS 503A Classical Mechanics I (Fall term)
- PHYS 506A Quantum Mechanics I (Fall term)
- PHYS 511A Electrodynamics (Spring term)
- PHYS 526 Statistical Physics (Spring term)

You must pass each of the four core courses with a grade of B- or better. Any C grade must be retaken. Retaking of courses is dependent on the evaluation of the student's overall performance in the program including research, teaching, and overall coursework.

Elective courses

Four elective courses must be completed by the end of the 3rd year of the program, prior to declaring candidacy. Often students take 1-2 electives during the first year of the program, and 2 electives during the second year. Descriptions for all physics graduate courses can be found at:

<http://www.physics.emory.edu/home/grad/graduate-classes.html>

If you do not have a senior advanced lab course from your undergraduate BS Physics degree, then you will need to take PHYS 544 Advanced Lab in your first year.

Electives can be any physics related course (500 level or above), which can include relevant courses in math, biology, or chemistry. Your PhD advisor or DGS should approve your course selection if outside the Physics graduate program. (Only one of the electives can be a Directed Study such as PHYS 597R).

A full course load for a fall and a spring term is 3 courses (9 credit hours with each course counting for 3 credit hours). If you are not taking 3 courses in the term, your remaining credit hours should be filled with PHYS 599R Thesis Research to total 9 credit hours for the term. (For example, if you are only taking one course counting for 3 credit hours, you would then register for 6 credit hours of PHYS 599R Thesis Research.) You must always register for a minimum of 2 credit hours of PHYS 599R (or 799R) Research, even if you are taking 9 credit hours of courses. In the summer terms, you will take 9 credit hours of 599R (Thesis Research) during pre-candidacy or 9 credit hours of 799R (Dissertation Research) post-candidacy.

Other “Administrative” Requirements

(Note these all count as credit hours on your transcript on top of the usual 9 credit hours per term of physics related courses or research.)

TATTO: Teaching Assistant Training and Teaching Opportunity

The Laney Graduate School expects each student to receive high quality teaching experiences, represented in four stages (which also show up on your transcript).

<https://gs.emory.edu/professional-development/teaching/overview.html>

The four stages of the TATTO program provide graduate students with credible training and optimal teaching experience, while ensuring that they are not overtaxed with teaching responsibilities. No student may serve more than a total of four terms in any combination of teaching assistantships and associateships during his or her first four years at Emory.

1. The first stage of TATTO is a short course offered in late summer, before the fall term begins. It should be taken immediately prior to a student's first teaching experience. Faculty for this course are drawn from among the best teachers across the University. The syllabus covers general topics of importance to all students, including syllabus writing and grading, lecturing and leading discussions, the use of writing as a pedagogical tool, the conduct of lab sessions, and the use of new technologies. Because the summer course is offered between terms, it is credited to a student's transcript the following fall when students register for TATTO 600.
2. In the second stage, students enroll in program level training that addresses intellectual problems and teaching strategies from the perspective of physics education. Optimally, students enroll in this course at the same time they participate in their first teaching opportunity, the teaching assistantship. See more information below.
3. The teaching assistantship, the third stage of the TATTO program, varies from department to department. In physics, this is represented by the first 2 terms of TA work. The teaching assistant is closely supervised by a faculty member who provides continuing guidance and evaluation. Usually this is Prof. Tom Bing. During either term of the teaching assistantship, the student registers for TATTO 605 (only once).
4. The teaching associateship, the fourth stage of the TATTO program, advances the graduate student to a teaching opportunity with greater responsibilities. During the term of the teaching associateship, students register for TATT 610. Often students are assigned a TA opportunity where they are able to teach a few lectures of an upper-level course, but this isn't always the case, depending on the preferences of the student, and the needs of the department.

Students who demonstrate exceptional teaching ability may be eligible to apply for appointment as Dean's Teaching Fellows. To be eligible for consideration, a student must have completed all graduate school and departmental requirements except the dissertation and must have been admitted to PhD candidacy. Dean's Teaching Fellows have complete responsibility for one course in the award year.

You must complete TATT 600 & 605 prior to declaring candidacy, and TATT 610 prior to graduation. Dr. Tom Bing handles organizing the teaching assignments. During your first two terms of teaching, you will also register for:

- PHYS 590A Seminar in Teaching (first TA term)

- PHYS 590B Seminar in Teaching (second TA term)

These are part of the teaching preparation during which Dr. Bing discusses the physics teaching literature and common misconceptions students get from traditional teaching methods.

There are also other opportunities for gaining additional teaching experience if you are interested in pursuing a teaching career. Share your interests with your PhD Advisor and Tom Bing.

ESL (English as a Second Language) Courses

International students often take some ESL courses before they can be approved to be teaching assistants. Thus, they often only start as teaching assistants during the fall term of their second year.

Ethics Training

The Laney Graduate School (LGS) developed the Jones Program in Ethics to provide students with a cross-disciplinary introduction regarding the ethical considerations in conducting research, in teaching, and in other areas of their careers. In addition, the National Institutes of Health (NIH) and the National Science Foundation (NSF), which are the major funders of our department's research efforts, require that students receive training in ethics.

This program occurs in three parts. You must complete (1) and (2) before you can declare candidacy, and (3) prior to graduation.

<https://www.gs.emory.edu/professional-development/jpe>

1. JPE 600 (first year, a 6-hour seminar covered in August)
2. Program-Based Instruction: Minimum of 6 hours covered within the physics graduate program. This requirement is often fulfilled by faculty-run workshops that occur 2-3 times per term. Students and faculty discuss scientific and workplace ethics through journal clubs and other group activities.
3. JPE 610 (attending a minimum of 4 workshops on campus). These are 1.5 hours sessions held by the LGS throughout the year. You are responsible for finding and attending these. JPE 610s are found on the LGS JPE website page and are also announced in the LGS GRAD Report that comes out every week during fall and spring terms. You will register for sessions you want to attend individually. Upon completion of JPE, participation is recorded on your transcript as JPE 610.

Research Requirements (the most important)

Finding a PhD Advisor – Research Rotations (first year)

In your first month, you are encouraged to talk to many faculty about their research. By the end of September, you will need to identify two possible PhD Advisors. Beginning in October and through the middle of April you will participate in rotations with each possible PhD Advisor. These rotations will allow you to explore research areas of interest.

During your rotations you will register for PHYS 599R Research (2 credit hours) graded as S/U each term. On your transcript, this will show up as an additional 2 credit hours on top of your 6-9 credit hours of physics related coursework (2-3 courses). In some cases, if a student is unable to identify a PhD Advisor from the rotations, a third rotation may be tried during the months of May and June. If a student receives a grade of “U” from one of their rotations, they may be placed on academic probation by the Laney Graduate School. If a student receives two grades marked “U” for their 599R rotations, this may lead to a recommendation of dismissal from the program to the Laney Graduate School.

First Summer of Research and Preparation for Qualifier

As outlined in the next section, once you have identified your PhD Advisor, you will formally start work on your PhD research. During your first summer term you will register for 9 credit hours of PHYS 599R Thesis Research. You should spend this summer learning and carrying out your research project, including extensive reading of the research literature.

In September of your second year, i.e. right after your first summer, you will be giving a 10-15 min APS-style talk to the graduate program about your research. By **mid-November**, you will submit a written research literature summary of your chosen PhD field. To assign a grade for your literature summary, presentation, and qualifier preparation, you will register for 3 credit hours of PHYS 598 Research Summary in the fall term of your second year.

Qualifier Proposal (second year)

Our graduate program’s qualifier process involves the writing, presenting, and defending of an independent research idea related to the students’ PhD research. Students start developing ideas for their qualifier proposal during their first summer term as they are reading the research literature of their chosen PhD field and are in discussions with their PhD Advisors.

In **late October** of their second year, students submit a brief summary (300 words) outlining the problem, hypothesis, and approach they have identified for their qualifier proposal. The viability of this idea will be reviewed by the PhD Advisor and DGS for the Physics Graduate Program.

Over the coming months, the student then develops this research idea into a full research proposal. The Qualifier process culminates with an oral presentation and defense of the student's research proposal given to their Qualifier Committee during spring term of the second year (typically mid March). A copy of the written proposal is submitted to the committee at least one week prior to the date and time of the defense.

The Qualifier Committee consists of 4 faculty members: the PhD Advisor and three faculty members within the Physics Graduate Program one of which is in a different research area; one of these three faculty members may be replaced with an Emory faculty member who is not a member of the Physics Graduate Program. Any external members needed to be approved by the Director of Graduate Studies. The members of the Qualifier Committee must be identified, and the date of the proposal defense set by February 15th. Students will register for PHYS 796 Qualifier Proposal in the Spring term of their second year.

Research towards your PhD

Note that whenever you are not taking courses, you will be registered for PHYS 599R Thesis Research (pre-candidacy), or PHYS 799R (post-candidacy). For example, in the summer terms

you register for 9 credit hours of PHYS 599R. To declare candidacy you need a minimum number of 24 credit hours of PHYS 599R research credit. Note Research courses PHYS 599R (pre-candidacy) and PHYS 799R (post-candidacy) are graded Satisfactory (S) / Unsatisfactory (U) based on whether the student is progressing satisfactorily towards the PhD, as measured by the expectations of the PhD advisor's research group. Students given a U for Research (regardless of the number of credit hours) will automatically be placed on probation. Two consecutive terms on probation is sufficient to lead to the recommendation of dismissal from the PhD program. Students must always be registered for a minimum of 2 credit hours of PHYS 599R or 799R Research, regardless of the number of courses they are taking.

Declaring Candidacy (third year)

Declaring candidacy means you have completed all of the above requirements for the PhD degree and all you have left to do is complete a body of original research worthy of a PhD. Students should typically declare candidacy in their third year of study. Students must reach candidacy by **September 15** at the start of their fourth year. Details and forms can be found on the LGS website:

<https://www.gs.emory.edu/academics/policies-progress/candidacy.html>.

Once you have declared candidacy and it has been approved by the Laney Graduate School, you are officially a PhD Candidate. You now register for PHYS 799R Advanced Research (instead of PHYS 599R), always 9 credit hours for a full term unless you decide to take another course for fun.

In the fall of your third year, you should ensure that you have all the requirements and apply for candidacy. To declare candidacy, you need to:

1. complete the 4 core courses and 4 physics appropriate elective courses
2. complete PHYS 598 Research Summary
3. pass the qualifier, PHYS 796 Qualifier Proposal
4. complete two terms of being a TA (TATT 600 & 605), plus PHYS 590A&B
5. complete JPE 600 the required 6 credit hours of graduate program ethics training
6. Take a minimum number of 24 credit hours of PHYS 599R research credit.
7. Form a dissertation committee by **March 15th** of the 3rd year, and complete the first committee meeting.
8. Earn at least 54 credit hours at the 500 level or above and be in good academic standing with a minimum cumulative GPA of 2.70, with no unresolved Incomplete (I) or In Progress (IP) grades.

For students that start in Fall 2017 or later, you must declare candidacy no later than **September 15th** of your fourth year. Students who do not meet this deadline will be placed on probation by the Laney Graduate School, will not be eligible to apply for Professional Development Support (PDS) funding, and may forfeit financial support. These sanctions will be lifted when the student enters candidacy.

PhD Dissertation Committee and Yearly Committee Meetings

Once students have successfully completed the qualifier process at end of the spring term of the 2nd year, they should form their PhD Dissertation Committee. Your PhD Dissertation Committee decides what is an appropriate "body of research worthy of a PhD". This consists of 5 faculty

members (the PhD Advisor, three faculty members within the Physics Graduate program one of which is in a different research area, and a faculty member external to the Physics Graduate Program that is familiar with the research area). These can be the same or different people from the Qualifier Committee. The external faculty member can be from a different institution (not Emory), but this must be approved by LGS by providing a letter which explains why this person has been chosen, and their CV must be provided. Students should contact the Graduate Program Coordinator for assistance with this letter.

Students must file their Dissertation Committee form with LGS and have it approved by no later than **March 15th** of their fourth year. Students who do not meet this deadline will be placed on probation by the Laney Graduate School, will not be eligible to apply for PDS funding, and may forfeit financial support. These sanctions will be lifted when the student submits the dissertation committee form:

<https://gs.emory.edu/academics/policies-progress/dissertation.html>

After your first dissertation committee meeting prior to candidacy, you are expected to meet with your PhD Dissertation Committee at least once a year to provide an update and discuss your progress towards the PhD degree. You must provide a 1-page written report to your committee that outlines basic progress and goals. A link to this form is provided on the Graduate Program website.

PhD Defense and submitting your Dissertation

To officially graduate you must defend your PhD Dissertation Research in front of your PhD Dissertation Committee and submit a completed dissertation that is approved by the committee to the Laney Graduate School. Forms and details are listed on the LGS website:

<https://www.gs.emory.edu/academics/completion/index.html>

As part of the defense, students will give a seminar talk to the graduate program, followed by the oral defense portion with your PhD Dissertation Committee. At least 2 weeks prior to your defense date and time, you should submit your completed thesis (approved by your PhD Advisor) to your PhD Dissertation Committee for reading and review.

Once all corrections have been completed and approved by your PhD Advisor and PhD Dissertation Committee, you can submit your completed and approved dissertation to the Laney Graduate School along with all the required forms and signatures. Note that the LGS deadlines for dissertation submission and degree completion in any given term are quite early. For example, to meet a May spring convocation deadline, you typically need to defend your PhD by the end of March to allow for enough time for corrections and submission before the LGS deadline in early April. So plan accordingly.

RESEARCH ROTATIONS AND THE 1ST SUMMER OF RESEARCH

Research Rotations – Identifying a PhD Advisor

Timeline

September	Meet with faculty and select two potential PhD Advisors
October – April	Complete two research rotations with prospective PhD Advisors

Rationale

The goal of the research rotations in the first year is to expose students to different areas of research and potential advisors, prior to settling down into one particular area for their PhD research. The timeline was designed to give both the student and advisor sufficient time and interaction to determine if they would work well together and to allow the student to gauge their interest in the subject area of research and determine if it is sufficient to sustain them for the duration of the dissertation.

From the student's perspective, the rotation is an opportunity to learn about different research projects and approaches currently being pursued in the group, while interacting closely with the potential PhD advisor and their group members. They should use this time to determine the desirability of the prospective advisor as a dissertation mentor, as well as their aptitude and interest in the research methods used by the group.

From the faculty's perspective, the rotation is an opportunity to interact closely with a student and thus, to gain an idea of the student's abilities as a potential dissertation student researcher. The student's performance (including aptitude, level of intellectual engagement, and work ethic) in the rotation will be regarded as an indication of suitability for continued work in the faculty member's group. The rotations also allow faculty an opportunity, outside of classes, to become familiar with students in the program.

During the rotation period, it is expected that the student will learn in detail about at least one project in the group and read relevant research articles to see how the project fits into the literature. The student is also expected to get "hands on" experience in the research project. For example, in the laboratory of an experimental faculty member, the rotation is expected to involve the acquisition, analysis, and interpretation of data, usually obtained with instrumentation that is the laboratory's specialty. In the group of a theory faculty member, the rotation would likely involve work on an aspect of the theory, or the development and application of a computational or simulation approach. The student is also expected to participate in the other activities associated with the laboratory, such as group meetings. In essence, the student is treated as a member of the group during the rotation period. This will allow the student to get a good feel for the particular research environment and their potential future colleagues.

Requirements in Fall and Spring Terms of First Year

Choosing potential PhD Advisors – During September of the first year, students will meet individually with at least five (5) faculty members to discuss the particular research area. This would likely involve a tour of the lab or other relevant research facilities, as well as a discussion of the current research projects being conducted in the group. The student is encouraged to meet and talk with current group members to get an appreciation for their day-to-day activities as a PhD student.

Two such potential PhD Advisors will then be selected for rotations, in consultation and agreement with them. The proposed timeframe for each rotation will be shared with the students and their rotation advisors by the DGS at the beginning of the fall academic term. Students and rotation advisors are expected to agree on the expectations for each rotation, since expectations can vary between experiment and theory groups.

Length of Rotations – Students shall complete two ~13-week rotations with two different potential PhD Advisors between the beginning of October and the middle of April. Students are free to start earlier if they have already identified one potential PhD Advisor. The goal for the rotation is for both the student and prospective advisor to evaluate the match.

Rotation Report – At the end of each rotation, students will be required to write a short summary report describing what they have learned about some aspect of the research going on in the group. This report is assessed as part of the S/U grade for the rotation. For example, students may pick one project and describe the basic goal of the project, a bit of the relevant literature, and how the research is carried out. This requirement enables the prospective PhD Advisor to evaluate the student's ability to read and understand research literature, construct a coherent and logical scientific argument, and describe scientific ideas in their own words. It also allows the potential advisor to assess the student's attention to detail and their ability to write. All these are elements needed for success in PhD level research.

The student should go through at least one round of feedback and revision on the written document by the advisor before submitting it to the Director of Graduate Studies. The reports will be due at the end of each individual rotation period. The overall format of the report should contain:

- Title, Name, Date, and Rotation Advisor
- Abstract (≤ 250 words)
- Body of text (~1500 words, roughly 5 pages double-spaced at 12 point font not including any figures or references as necessary)
- References

Additional requirements for the rotations are at the discretion of the rotation advisor. It is expected that the student will participate in the group meetings and journal clubs associated with this advisor (basically “join” the group). As part of their evaluation of the student, advisors are free to require presentations by the student at relevant group meetings, as well as other tasks such as sample preparation, data collection, analysis, calculations, coding, etc. The potential advisor is free to evaluate those skills they consider the most important in judging the student's ability as a potential researcher in their group.

First Summer of Research – Getting up to Speed on PhD Research Literature

Timeline

May – August Begin research project with chosen PhD Advisor, including an intense reading of literature in the chosen field of research as preparation for Qualifier proposal

Early September Give oral research presentation to Physics graduate faculty and students

Mid November Submit Research & Literature Report

Rationale

Now that the student has identified their PhD Advisor, they can begin their formal training and research in their chosen area of research. During the first summer, students begin their PhD research under the direction of their chosen dissertation advisor. As part of the training for doing PhD level research, students will write an in-depth literature and research summary of their chosen PhD area, and give a presentation of their research progress to the physics faculty and students in a 10-min APS-style talk in early September.

The principal goals over the summer are for the student to gain experience in how the research process is carried out in their specific area of PhD research in preparation for the Qualifier proposal. This in-depth education and training with guidance from the advisor will emphasize literature assimilation, and quasi-independent acquisition, analysis, and interpretation of methods and data. The student should spend a great deal of time reading and familiarizing themselves with the research literature in their chosen field of research. This is necessary to provide a strong foundation for developing their own independent research ideas in moving forward in the PhD. The written research report and oral presentation are designed to hone organization and communication skills that will benefit the preparation and presentation of the Qualifier proposal.

The oral presentations in early September offer an excellent opportunity for both the graduate faculty and graduate students to become better acquainted and to learn basic features of the research currently being performed in the graduate program. It also forms a nice introduction to the graduate program for new graduate students entering the program and facilitates and encourages cohesion in the Physics graduate program community.

Requirements

Research & Literature Report – A detailed research and literature report will be written by the student by **mid-November** of the second year. Since the project described in the report will form part of the student's PhD work, the written report should contain a strong description of the research literature, including a detailed overview of the state of the field for their chosen PhD area, and a progress report on their research efforts to date. After report feedback from the PhD Advisor and any necessary revisions, a copy of the final revised report should be submitted to the Director of Graduate Studies no later than November 15th. The student should not leave the writing of the report to the last minute as the level of detail required and time for revisions typically take approximately three (3) weeks after the student has completed the first draft. The report shall be a minimum of 10 pages (typed, doubled space; not including illustrations, figures, and tables), and be composed as follows:

- Title, Name, Date, and PhD Advisor
- Abstract (≤ 200 words)
- Introduction (≥ 3 pages)

The Introduction includes a clear statement of the goals of the project, the current literature context for the particular problem or issue to be addressed, and its significance. The relevant background literature for the project is described in sufficient detail for the reader to become informed of the main issues.

- **Methods (≥ 2 pages)**
The experimental and/or analysis techniques used should be briefly described and their sources cited. (If a new experimental method or technique is being reported, then this should be described in the Results section.)
- **Results (≥ 3 pages)**
The main results and their meaning should be reported logically. Similar to research articles, all figures and tables should be described in the body of the text.
- **Discussion (≥ 2 pages)**
The interpretation of the data and associated analysis should be described and explained, as well as the meaning and significance of the results with respect to existing literature. Future experiments or approaches should be suggested. (The Results & Discussion sections may be combined if the logical flow of the arguments is more clear in this fashion, but it should not be used as a way of reducing the amount of discussion and interpretation of results.)
- **Conclusions**
The main conclusion(s) and their significance should be briefly summarized.
- **References**
Sufficient publications should be referenced and cited to demonstrate that the student has developed a working knowledge of the current state of their chosen PhD research area. It is assumed that the student has a reasonable understanding of the content of these references.

Oral Presentation – The oral research presentation will be a 10-minute APS-style talk followed by a 5 minute question period given to the graduate program faculty and students. The presentation will summarize the student’s research progress over the summer, describing their project, results to date, the relevant literature, and its significance. The dates of the student presentations will be set by the Director of Graduate Studies, to be held in early to mid September. This information will be provided to the students by the DGS at the beginning of the fall term.

Grading

For the rotation sequence, students will register for 2 credit hours of PHYS 599R Research in both fall and spring terms of their first year. The fall term represents the 1st rotation, and the spring term represents the 2nd rotation. The Director of Graduate Studies will be the instructor of record on OPUS, but evaluation will be done by the Rotation Advisors. The Director of Graduate Studies will consult with both faculty members that were rotation advisors for the student and ask them to evaluate the student’s rotation with them that reflects the student’s participation in research and group activities, their performance in the written report, and any other evaluation of skills the rotation advisor considered important to their success in a PhD program. PHYS 599R Research is graded Satisfactory (S) / Unsatisfactory (U), where an S indicates that the student is progressing satisfactorily towards the PhD. For the Research Rotations, this means the student adequately met the expectations of the rotation, and often (but not always) means the advisor is willing to take the

student on as a PhD candidate. A grade of U will be assigned to students who do not adequately complete the Research Rotation. A grade of Unsatisfactory (U) in PHYS 599R Research will automatically place the student on probation, regardless of the number of credit hours taken. Two consecutive terms on probation are sufficient to recommend dismissal to the Laney Graduate School from the PhD program. Students who are unable to identify a PhD Advisor from the Rotations may be given the opportunity to try a third rotation with another faculty member during the month of May. If a student does not identify a PhD Advisor during the summer another U will be given in 599R Research leading to recommended dismissal from the program.

During the fall term of their second year, students will register for PHYS 598 Research Summary, a graded course. The chosen PhD Advisor will be the instructor of record on OPUS. The instructor of record will determine a letter grade at the end of the fall term that reflects the student's performance in research. The student and the PhD advisor should agree on research expectations prior to fall term. This evaluation of the student's progress on the research project will be based on the following factors: quality of the student's work, conscientiousness and degree of time and intellectual commitment, trainability, and sophistication in the level of approach to the project. Note that these evaluation factors are distinct from any emphasis on the significance, importance, or publishability of the results obtained. The student's level of understanding of the material will be gauged by their written research and literature report and their oral presentation to the graduate program community.

PHD QUALIFICATION PROCESS & QUALIFIER PROPOSAL

Introduction and Rationale

The PhD Qualification Process takes place in students' second year. This process is designed to assess the readiness of the student for the final stage of the PhD degree program, which is determined by the performance of original research work and the organization and presentation of that work in oral (dissertation defense) and written (dissertation) forms. The assessment is based on the Qualifier Proposal, which involves the independent preparation of a research proposal that is conceived, literature-researched, and presented in the spirit of a research proposal. Along with the stylistic aspects of organization and presentation, the strength of the Qualifier Proposal will be evaluated on the basis of whether it offers a logical and consistent approach to the chosen problem, and on the assessment of the committee members that the proposal offers a reasonably successful solution to the problem.

The Qualifier Proposal and associated Oral Examination aim to assess the student in the following four areas that are required for success in the final stage of the PhD program:

- (a) a general understanding of the fundamentals of physics,
- (b) the ability to think originally and creatively about a specific problem or topic, and to translate this thinking into conducting research,
- (c) scholarship (depth and scope of knowledge) in the area of research, and
- (d) the ability to organize and clearly communicate the results to the scientific community.

Specific Requirements for the Qualifier Proposal

1. The **Proposal Topic Area** will be selected by the student, typically in consultation with their PhD Advisor.
2. The specific Scientific Goal of the Proposal must address a well-defined problem in a subfield of physics. This goal will be identified by the student and should be a hypothesis, method, or exploration that is motivated by and embedded in a substantial discussion of the pertinent scientific literature. The possible outcomes of the approach and its potential impact on the existing literature, as well as the possible degrees of uncertainty in the methods, should be discussed in detail. Evidence must be provided that justifies that the proposal ideas are valid. This can take the form of referring to existing literature, calculation or coding by the student, or some preliminary data. (However, note that the student should not waste their time figuring out preliminary experiments or debugging code. Thus, justification is likely best taken from the existing literature.)
3. The **Hardcopy Written Form of the Proposal** shall be at least 25, and not more than 40, pages long (typed, double spaced; not including illustrations, figures, and tables), and contain the following sections: Title, Abstract (<250 words), Introduction, Proposed Experiments (or Proposed Simulations, or Proposed Theory) and Expected Results,

Discussion, Principal Conclusions, and References. The committee will receive the written version of the Qualifier Proposal by noon at least one week prior to the oral presentation.

4. The prepared **Oral Presentation of the Proposal** will be a minimum of 30 and a maximum of 40 minutes in length (not including the question/answer periods during and after the presentation), and the entire examination will not exceed 90 minutes. The presentation will be closed (student and committee members only). Committee members may ask the students questions about fundamental physics concepts at any point. Following the presentation, the committee members will meet privately to decide the pass/fail outcome of the Qualifier Proposal.
5. The **Proposal Committee** shall consist of four (4) faculty members. At least three shall be members of the Physics Graduate Program, one of whom should be in a research area that is different from the area of the Qualifier topic. An faculty member external to the Physics Graduate Program, but still affiliated with Emory, may be chosen for their expertise or familiarity with the subject area of the proposal. Typically, the PhD Advisor heads the committee. Otherwise, the Director of Graduate Studies appoints one of the designated members as head of the committee. The PhD Advisor is in charge of the proper execution and reporting of the examination.
6. **Timetable:** Before mid-November of the second year, the student will submit to the Director of Graduate Studies a title for the Qualifier Proposal and a brief summary (300 words) outlining the problem, hypothesis, and approach. The Director of Graduate Studies in consultation with the PhD Advisor will examine the proposal summary, and give the notice to proceed with, or modify, the Qualifier Proposal by early December. The members of the Qualifier Committee must be identified and the date of the proposal defense set by early February. The Qualifier Proposal defense shall be completed before the beginning of April of the second year (typically early March).
7. The committee will inform the student of the **Outcome of the Qualifier Proposal** following their meeting after the oral presentation. If the student has failed the examination, at the discretion of the committee, the student may be allowed to present a revised Qualifier Proposal by the end of April. On passing the Qualification process, the student has officially reached the dissertation stage. If the student fails the revised Qualifier Proposal, the DGS will recommend to LGS that they be terminated from the Physics Graduate Program.
8. **Grading:** Students will register for PHYS 796 Qualifier Proposal in the Spring of their second year and the Qualifier Committee will assign a grade based on the student's success in the qualifier proposal.

REQUIREMENTS FOR A MS DEGREE IN PHYSICS

Students are not admitted into the Graduate Program in Physics to pursue the M.S. degree. Some students admitted to the doctoral program may leave the program before completing the requirements for a PhD. Students may have the option of a terminal M.S. degree if they leave the Ph.D. program. Typically, students have one term to complete a terminal MS after being approved to pursue the MS degree.

Credit Hours Requirement

A minimum accumulated of 30 credit hours in courses 500 level or above in the Graduate School is required for the M.S. degree.

Specific Course Requirements

In addition to the general credit hour requirements, minimum specific course requirements for the M.S. degree are:

1. Satisfactory completion of 18 hours of credit, of which 15 must be in course or seminar work, not including Directed Study (Physics 597R) or Research (Physics 599R).
2. At least 11 of the hours in course or seminar credit must be on the 500 or 700 level.
3. A grade of B- or better must be earned in at least 11 hours of course work taken.
4. No course on the 100 or 200 level may be applied to a master's degree program.

Students are required to take the following three core graduate courses:

1. Physics 503a Classical Mechanics I (3 hr)
2. Physics 506a Quantum Mechanics I (3 hr)
3. Physics 511a Electrodynamics I (3 hr)

It is assumed that the student will also complete introductory graduate courses in more specialized areas such as statistical physics or biophysics, depending on the master's thesis topic.

Thesis and Thesis Advisory Committee

The student must submit an acceptable thesis demonstrating an ability to use advanced methods of research. The Thesis Advisory Committee is composed of the thesis advisor, two additional physics faculty members, and one faculty member from another graduate program at Emory. The Thesis Advisory Committee approves the topic for the candidate's research. The committee also reads and approves the thesis before it is submitted to the office of the Graduate School, and acts for the graduate program in recommending the candidate for the M.S. degree. As part of the defense, students will give a seminar talk to the graduate program, followed by the oral defense portion with your M.S. Thesis Committee. At least 1 weeks prior to your defense date and time, you should submit your completed thesis (approved by your M.S. Advisor) to your Committee for reading and review.

GRIEVANCE POLICY AND CHANGING PHD ADVISORS

Grievance Policy

The Graduate Program in Physics recognizes that a fair and rigorous assessment of a student's performance and progress towards the PhD is vital to the mission of the graduate program. The PhD necessitates a close, working relationship between the student and the advisor, and involves multiple courses and checkpoints of assessment where the student is evaluated by individual faculty instructors and faculty committees. Disagreements arising over assigned grades or other academic matters that may arise should be handled promptly and professionally.

Students with a grievance related to some aspect of their treatment in the physics graduate program should address a comprehensive written account of the grievance to the Director of Graduate Studies. A Grievance Committee consisting of 3 faculty members within the Physics Graduate Program will consider the grievance based on the written complaint. Committee members will be recused and replaced as necessary depending on the nature of the grievance. The student will also be allowed the opportunity to present their case to the committee in person. As part of the decision-making process, the Grievance Committee may consider other sources, including, but not limited to, the research advisor and the Graduate Program Coordinator. The Grievance Committee will then inform the student of their response to the grievance.

If it is impossible to resolve the grievance within the Grievance Committee or within the broader framework of the Department of Physics administrative structure, the Director of Graduate Studies will forward the grievance to the Associate Dean of the Laney Graduate School. From this point forward, the grievance will be handled according to the procedures outlined in the Laney Graduate School handbook. If the issue is with the Director of Graduate Studies, the scholar should go directly to the Associate Dean of the Laney Graduate School or the Assistant Dean for Student Affairs.

The grievance process is primarily appropriate for academic complaints, broadly defined, related to coursework, exams, milestone requirements, laboratory environment, and training, etc. While the graduate program takes the perspective that all aspects of a scholar's Emory experience may impact their academic work, there are certain instances where it is most appropriate or even required that a student reach out to a particular office to officially pursue a concern, complaint, or resource. Scholars should familiarize themselves with the resource list in the "Resource Guidance" section of the handbook for assistance in determining the appropriate office for handling a non-academic concern. If a scholar cannot determine where to bring a complaint or grievance, they are encouraged to contact any member of the graduate program team or, if the issue cannot be comfortably discussed within this structure, the Assistant Dean of Student Affairs of the Laney Graduate School or the Associate Dean for Diversity, Inclusion, and Community Engagement.

Changing PhD advisors

On rare occasions, students well into their PhD research may experience unresolvable conflicts, often mutual, with their PhD advisor. The Emory Physics Graduate Program strives to provide students with a “good fit” research advisor in order to make progress towards the PhD. If such a conflict arises, the student and/or faculty member should first discuss the situation with the Director of Graduate Studies. If a change is necessary, it is primarily the graduate student’s responsibility to contact new potential advisors. This process is often guided by advice from the Director of Graduate Studies. After this, if a suitable match is still elusive, then the student and Director of Graduate Studies will discuss the issue with the Chair of the Physics Department. PhD advisors **MUST** be members of the Physics Graduate Program, with few exceptions in special cases.

FUNDING

All physics graduate scholars are admitted with a stipend, 100% health insurance subsidy, and 100% tuition scholarship. Funding is guaranteed as long as the scholar continues to make satisfactory progress towards the degree.

Graduate scholar stipend support comes from a number of sources, including:

- Laney Graduate School fellowships
- Teaching Assistantships
- External fellowships
- Faculty research grants

Scholars receiving any form of stipend support are expected to devote themselves full time to graduate work and research. Outside employment is not permitted. The only exception is tutoring which must be kept to ten hours or less per week. Breaks and vacations longer than 2 weeks per year should be agreed upon by the student and their advisor. Scholars who take extended breaks that have not been approved by the advisor or the DGS may have their stipends terminated.

Additional Funding

Professional Development Support (PDS) funding is available for research travel, conferences, and training via the Laney Graduate School:

<https://www.gs.emory.edu/professional-development/pds/index.html>

Scholars should familiarize themselves with program guidelines and take advantage of this support. Two additional travel grants of \$250 each are available by application to the Laney Graduate Student Council (LGSC):

<https://emory.campuslabs.com/engage/organization/laney-graduate-student-council>

Scholars are encouraged to research and apply for grants relevant to their graduate work, including, but not limited to, the NSF Graduate Research Fellowship Program (GRFP). Scholars should carefully review email digests from Laney Graduate School and the Department of Physics for potential funding opportunities and explore funding opportunities from professional organizations and government agencies. When a scholar receives an external stipend that fully replaces 75% or more of the annual program stipend, they are eligible for an additional \$2,000 annual stipend supplement from LGS. Refer to the Special Funding Requests page for instructions - students should proactively request this supplement if they become eligible:

https://www.gs.emory.edu/funding/scholarships/special_funding.html

Stipend Termination

A scholar's stipend may be terminated due to:

- degree completion
- transfer to another institution

- leave of absence (pause of stipend funds)
- withdrawal (either voluntary or required based on academic performance)

In the case of transfer, leave of absence, or withdrawal, the stipend will usually terminate immediately upon the effective date for the change of status in an official leave from the Laney Graduate School. The student's advisor will inform the Graduate Program Coordinator of the stipend change.

For graduating scholars, the stipend will terminate automatically at the end of the term in which a scholar graduates. However, faculty have the option of terminating the stipend early if the student is completing their work or defending their thesis on an earlier date. The end of the stipend for graduating students should be clearly communicated between the student, advisor, and Graduate Program Coordinator.

MERIT AWARDS

While graduate students cannot self-nominate, scholars are encouraged to make their research advisors aware of awards for which they may be eligible. The department currently has 2 internal merit awards to recognize outstanding student achievement, listed below. Each year, the DGS will send out a solicitation for these awards with application instructions. This usually happens at the beginning of the spring term.

Montag Award

The Jim and Ethel Montag Graduate Physics Award is awarded annually to an exceptional graduate student for accomplishments in physics research. Recipients receive an additional \$2000 to their stipend the year they receive the award. The award is granted to the student (US Citizens only) with the most significant accomplishment in research. This award was initiated in the 2014-2015 academic year. The Montag Graduate Physics Award was established by James L. Montag (58C) and his late wife Ethel in honor of Prof. Fereydoon Family, for his mentoring and academic influence of their son Lee Montag (85C).

Excellence in Graduate Research

The Excellence in Graduate Research Award is given annually to a physics graduate student with outstanding research accomplishments. It is open to all physics graduate students with no restrictions. Recipients receive an additional \$500 to their stipend for the award. The award is currently funded by the Emory Department of Physics.

COMMUNICATION AND CULTURE

Communication policy

Email is the primary medium for official communication between scholars, faculty, and staff in the Department of Physics and the graduate program at Emory University. Individual research groups may use other means of communication that pertain specifically to each group. Official Department of Physics communications will be sent to your emory.edu address. Time-sensitive communications will be sent to your email with the expectation that they will be reviewed within 24 hours or less.

Department Calendar

Events of interest in the department, including weekly seminars, are posted on the Trumba calendar that appears on the news page of the departmental website:

<http://www.physics.emory.edu/home/news/index.html>

Scholars are encouraged to subscribe to this calendar. Events are also posted throughout the department and announced via email.

Communicating Theses Defenses, Seminars, and Research Advances

Students are expected to contact Barbara Conner (barbara.conner@emory.edu) to advertise their thesis defense or other special events. For website materials, please use this link: [The Horizon Physics Blog & News Content Submission Form \(google.com\)](#).

Expectations and Departmental Events

All graduate students are expected to attend both in-person and virtual departmental colloquia whenever possible. This is vital to the broader scientific education of all students in disparate fields of research. The department also hosts a number of picnics and parties for all students, faculty, and staff. We strongly encourage you to attend these social events as well to maintain a cohesive and collegial graduate program culture.

Young Emory Physicists

The Young Emory Physicists (YEP) is a graduate student organization whose purpose is to promote interaction among Emory Physics Department graduate students and other Emory students interested in Physics. YEP is sanctioned by the Emory Student Government. Activities are held throughout the year and include leisure events and forums for the discussion of topics in physics. YEP also provides support for new graduate students in the Physics Department, through informal groups chats and advice about housing, etc. YEP aims to promote Emory Physics and to maximize the quality of life among Physics graduate students.

RESOURCE GUIDANCE

Emory University offers a number of resources to scholars enrolled in academic programs. You are encouraged to familiarize yourself with these resources by reading your email, exploring university websites, visiting university offices in person, and beyond.

The following list should not be considered exhaustive. It is provided as a resource to help you begin the process of learning what resources the university has to offer.

Please review the department website at <http://physics.emory.edu> to ensure you are familiar with physics-specific resources. Each member of staff has a short description next to their name describing key responsibilities in the People directory. In addition, the faculty diversity and safety liaison and the directors of academic programming will be identified in the People directory.

Within the graduate program structure, you are encouraged to consider the DGS, Graduate Program Coordinator, and Communications and Outreach coordinator as a resource team. Most academic process questions and signature requests will be addressed by the Graduate Program Coordinator.

Office of Respect (<http://respect.emory.edu>)

- Sexual violence awareness and prevention
- Victim support (Note: Scholars who have been victimized are encouraged to contact the Office of Respect for assistance prior to OEI if they can safely do so. If scholars are engaged in an active Title IX investigation, the Office of Respect can only play a limited role.)

University Ombuds Office (<https://ombuds.emory.edu>)

- Problems, conflicts, or concerns from students affiliated with any academic division of Emory University. Problems, conflicts, and concerns can be academic or non-academic in nature.
- Confidential discussion except where reporting is required by law, such as in cases of sexual assault or misconduct or when, in the judgement of the Ombudsperson, there appears to be imminent risk of serious harm.

Environmental Health and Safety Office (EHSO, <https://www.ehso.emory.edu>)

- Safety concerns, questions, and complaints
- Anonymous reports: Emory Trust Line

Laney Graduate School (LGS)

Scholars may consult the Assistant Dean of Student Affairs or the Assistant Dean for Diversity, Inclusion and Community Engagement for academic and non-academic concerns, and/or if it is not clear which resource would be appropriate.

<http://www.gs.emory.edu/guides/students/support.html>

LGS Parental Benefits and Parental Accommodation Policy

<https://gs.emory.edu/guides/students/parental.html>

Department of Accessibility Services

<https://accessibility.emory.edu/>

LGS Emory Diversifying Graduate Education (EDGE)

<https://www.gs.emory.edu/diversity/index.html>

LGS Professional Development and Career Planning

<https://www.gs.emory.edu/professional-development/index.html>