PhD in Astronomy

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The objective of our PhD program is to prepare students for careers in astronomical research and university-level education. To accomplish this, we emphasize:

- Acquisition of a broad knowledge of astronomy and familiarity with both observational and theoretical techniques;
- Exposure to a variety of advanced and specialized topics in modern astronomy;
- Extensive "hands-on" research, including supervised research projects undertaken in the first years of graduate school;
- Experience presenting talks reviewing the literature and describing new research.
- Formulation of an original dissertation research project;
- Experience writing research papers and observing proposals;
- Publication of results in peer-reviewed journals; and
- Public defense of the research before IfA astronomers and other scientists.

As the introduction to the Astronomy Graduate Program indicates, there are two possible paths toward a PhD in astronomy. Students starting with a Bachelor's degree (or a Master's degree in a field unrelated to astronomy) take a series of courses and research projects during their first two years. Students who already have a Master's degree or equivalent in astronomy, physics, or a closely related field are exempt from many of the requirements. Both paths converge at the Qualifying Examination, which is required of all students. Subsequently, all students propose a dissertation topic in the Comprehensive Examination, research and write a PhD dissertation, and defend it in a Final Examination.

Students entering with BA/BS degrees

Most students enter our program with Bachelor's degrees. During their first two years, they are required to take a series of courses and to undertake two directed research projects. They progress toward the PhD by taking the Qualifying Exam by the start of their fifth semester.

Formal requirements

UNIVERSITY

- Maintain cumulative GPA of 3.0 or higher
- Take and pass Comprehensive Exam
- Research and write Dissertation
- Take and pass Final Exam/Defense within seven years of admission
- See Official PhD requirements

ASTRONOMY PROGRAM

- Take 30 credits of grad-level astronomy (or equivalent – see below), including:
  - ASTR 633 (Astrophysical Techniques)
  - At least 3 credits of ASTR 7XX
  - No more than 9 credits of ASTR 699 counting toward this total
- Satisfactorily complete two directed research projects
- Pass Qualifying Exam (grade "P*") by end of 5th semester
- Pass Comprehensive Exam by end of 6th semester

Getting a MS degree

The departmental requirements for students entering the PhD program with a Bachelor's degree are a super-set of the requirements for students earning a "non-thesis" (Plan B) Master's degree; consequently, students passing the Qualifying Exam earn a MS degree while continuing toward the PhD. See "Receiving the MS degree" for instructions on how to collect your sheepskin.

Students entering with MA/MS degrees

Students admitted to the PhD program with a Master's degree or equivalent in astronomy or a closely related field (e.g., physics or planetary geosciences) often — but not always — have extensive coursework and research experience. Some may be ready to take the Qualifying Exam on arrival, while others may need considerable preparation. The astronomy program requirements for students entering with a MA/MS are necessarily somewhat flexible. Most students entering with a Master's degree complete these requirements within one year and take the Qualifying Exam at the start of their third semester. These students also have the option to be based at any of the Institute for Astronomy branches (Mānoa, Maui, or Hilo) immediately upon

entering the program. Placement at the IfA-Maui or IfA-Hilo facilities is contingent upon funding for an assistantship, and applicants are encouraged to contact potential research advisors during the admissions process.

Formal requirements

UNIVERSITY	ASTRONOMY PROGRAM
• Maintain cumulative GPA of 3.0 or higher • Take and pass Comprehensive Exam • Research and write Dissertation • Take and pass Final Exam/Defense within seven years of admission • See Official PhD requirements	• Take 3 credits of grad-level astronomy per semester prior to taking the qual exam • Take at least 3 credits of ASTR 7XX • Satisfactorily complete a directed research project or submit prior work (see below) • Pass Qualifying Exam (grade "P*") by end of 5th semester • Pass Comprehensive Exam by end of 6th semester

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Coursework

The core of the graduate astronomy curriculum is a series of "600-level" three-credit courses that provide a broad base to which specialized knowledge can later be added. PhD students entering with a Bachelor's degree typically take at least six of these courses, including ASTR 633 (Astrophysical Techniques). Most courses are taught on a two-year cycle, but ASTR 633 and ASTR 635 are currently offered each Fall.

In addition, there are a number of "700-level" courses, most consisting of short, specialized seminars on topics closely related to ongoing research at the Institute. These are usually given for one credit. Most courses change from year to year and some are taught by visiting scientists; two 700-level seminars, ASTR 740 and ASTR 777, are presently offered on a regular basis. Students need to take at least three credits of 700-level seminar courses.

Normally students take all their courses within the astronomy program. However, a student may ask the graduate chair for permission to substitute a course from another program, such as physics, mathematics, or planetary geosciences, so long as the substitution forms part of a coherent plan of study.

Directed research

There's no substitute for real astronomical research experience early in one's graduate career. The IfA graduate program puts considerable emphasis on research, even during the first two years when students are also taking formal courses. This research is normally done in collaboration with a faculty advisor as Directed Research (ASTR 699).

During their first semester, most students take ASTR 699DR, a directed reading course surveying ongoing research at the IfA. During their second, third and fourth semesters students normally carry out two substantial pieces of research, usually with two different faculty advisors. An independent oversight committee (the GROG) assists in the selection of research topics, and offers advice and feedback throughout the pre-thesis research period. The GROG is also responsible for evaluating papers and presentations.

PhD students entering with a Bachelor's degree are generally expected to complete two ASTR 699 projects, although in some cases a single expanded project may be accepted instead. Students entering with a Master's degree may submit research done at other institutions; if this is accepted they are excused from the directed research requirement.

Qualifying Exam

The Qualifying Exam, which evaluates a student's overall knowledge of astronomy, is offered each June. Most students entering with bachelor's degrees take this exam at the end of their fourth semester, although anyone wishing to do so can undertake the exam early. Students entering with master's degrees may take the exam at the end of their second semester.

The exam has three possible outcomes: a student getting a "P*" grade qualifies for a MS degree *and* is ready to continue toward the PhD, a student getting a "P" grade qualifies for a MS degree, and a student getting a "F" grade fails the exam.

The Qualifying Exam is normally an oral exam, and a satisfactory ("P*") grade is required to pass the exam. A written exam is only given to students who have not received a "P*" on the oral exam. The oral exam is administered by a committee of four faculty members. Students who get a "P*" on the oral exam are finished with the exam process. Students receiving "P" or "F" on the oral exam have the option to take the written exam roughly one month later.

Achieving PhD candidacy

Before advancing to PhD candidacy, a student must complete all coursework with a minimum GPA of 3.0, complete all directed research projects to the satisfaction of the GROG, and pass the Qualifying Exam Assessment with a grade of "P*". The next tasks are to:

- Select an appropriate dissertation topic and develop a detailed dissertation proposal explaining how the

research will be undertaken;
- Assemble a doctoral committee with the help and approval of the graduate chair;
- Set a time for, and pass the oral comprehensive exam.

Comprehensive examination

The comprehensive examination is carried out by the doctoral committee.

Committee members may examine the student on any aspect of astronomy they choose, but they usually pay most of their attention to the student's dissertation proposal. The format of the exam is determined by the committee chair, but in the past students have usually been invited to present their dissertation research proposal to the committee, and then address any comments or criticisms of it that the committee may have.

According to university regulations, any member of the University's graduate faculty may attend the examination; all members of the major field of study are invited and all members of the doctoral committee must be present at the oral portion and must participate in judging the entire examination. It is the responsibility of the candidate to inform the graduate faculty of the date, time and subject matter of the examination.

After the exam, Doctoral Student Progress Forms I (Pre-Candidacy Progress) and II (Advance to Candidacy) need to be signed by the committee and submitted to the graduate chair. Candidates should bring copies of these forms to the exam.

Passage of the comprehensive examination implies approval of the dissertation topic and leads immediately to the granting of candidate status.

Two attempts at the comprehensive examination are allowed by the University.

It is a strict policy of the astronomy program that students must pass the comprehensive exam by the end of their sixth semester if they are to continue in the PhD program. Exceptions to this policy are permitted only under unavoidable circumstances such as incompatibilities in the travel schedules of committee members.

During the period while students are preparing for the comprehensive examination they should register for ASTR 699.

Applying for telescope time

Graduate students may submit one observing proposal as principal investigator. Proposals can involve one or multiple telescopes. Prior to advancing to candidacy, students are eligible to apply for telescope time on the UH 2.2-meter, UKIRT, and up to 2 hours of time on Gemini or CFHT. Once they have advanced to candidacy, they can submit proposals for any telescope. Additional details are here. Note that student-led proposals receive no special consideration or long-term status from the TAC but are reviewed on an equal basis wiith all other proposals.

Doctoral committee meetings

The student should meet regularly with the doctoral committee chair, and report to his/her complete doctoral committee at least once a year, preferably more often. Committee meetings are particularly useful if it becomes necessary to redefine the scope of a dissertation project, or if the relationship between student and chair becomes strained.

Writing the dissertation

Students must write a dissertation that conforms in style with the "Style & Policy Manual for Theses and Dissertations" available from the Office of Graduate Education (formerly Graduate Division).

The PhD dissertation guidelines for the astronomy graduate program were adopted at a graduate faculty meeting in 1981. The policy requires, *inter alia*, that the principal section of the dissertation be acceptable and ready for publication in a reputable scientific journal with minimal changes.

LaTeX macros have been written by past astronomy graduate students to facilitate the conversion of papers drafted in ApJ style into the appropriate UH dissertation format.

Submission and final exam

When you are ready for your final exam you must work with your committee to find a suitable date and time. The Office of Graduate Education requires *at least* three weeks advance notice so that the exam may be announced in the University calendar. There are also deadlines each semester for

- applying for the degree,
- holding the final examination, and
- submitting the dissertation in a final form to the Office of Graduate Education.

If you want to graduate at the August commencement you must register for one credit of Astro 800 for summer session.

The Office of Graduate Education regulations specify that the dissertation be submitted to the committee four weeks before the final exam. This rule has rarely been followed in the astronomy program. As a result, committee members sometimes feel they don't have time to read a dissertation in detail. This problem can to some degree be avoided if candidates submit preliminary versions of individual chapters as they become available. However, to insure that committee members have time to do their jobs, candidates are **required** to

submit a substantially complete draft to their committee members **and** to the graduate chair at least 14 days before the final exam - or even earlier if committee members are on travel.

The dissertation submitted to the committee members must be in final format, even if the candidate expects to make revisions after the examination. In particular, it should contain:

- an abstract describing the work in the dissertation;
- an introduction placing the work in context and outlining the chapters which follow;
- text in reasonably clear English for each chapter;
- figure captions giving enough detail for the reader to understand the figures;
- complete references for each work cited;
- spelling which has been checked **at least** once!

The final examination is open to the public. All members of the doctoral committee must be present at the final examination.

The examination format usually adopted in the astronomy program is for the student to present the results of his/her research in the form of a colloquium address lasting 45-60 minutes. The chair then invites members of the audience to ask general questions about the candidate's talk for a few minutes. The audience is then invited to either leave, or to stay and witness the detailed examination of the candidate by the committee. Finally the committee meets in executive session to decide whether the candidate has passed the examination and, if so, what modifications are required before the dissertation be accepted.

Results of the exam are communicated to the university via the graduate chair on the Doctoral Student Progress Form III (Final Examination and Approval of Dissertation). Candidates should bring this form to the exam, and submit it to the graduate chair after their committee has signed it.

The seven-year time limit

It is a university rule that candidates must finish all work for the degree within seven years of entry into the program, otherwise they are automatically dropped from the program. Reinstatement for a limited period of time is possible only upon favorable recommendation of the field of study and with the concurrence of the Dean of the Office of Graduate Education.

Leaves of absence

A student may request a leave of absence for the program for a period of up to one year. Such an action should be discussed with the student's PhD committee and the graduate chair. There is, of course, an Office of Graduate Education form for applying for a leave of absence.

Nomenclature

Be aware of some differences between Office of Graduate Education phraseology and the common usage in the astronomy program. According to Office of Graduate Education:

- A PhD candidate writes a dissertation, not a thesis. Theses lead only to masters degrees.
- A PhD candidate has a doctoral committee, not a thesis committee.
- There is no such person as an advisor. That role is undertaken by the chair of the doctoral committee
- After you submit your dissertation you are subjected to a final examination, rather than a thesis defense or a PhD oral.