

The Comprehensive Exam

The comprehensive exam (Comps) is taken by all students in the Astronomy Graduate Program in the spring quarter of their second year.

No student is without their "gaps" in astronomy background and preparation, so the exam will not be derailed if you come across a topic or two with which you are not particularly familiar. What we will be seeking, however, is a demonstration that you have a substantial grounding in most areas of astronomy, and that you are capable of applying what you know to make sense of a given problem and to approach a solution.

Purpose of the Exam

The purpose of the comprehensive exam is threefold:

1. to assess students' general knowledge of astronomy and physics, and ensure that they have the necessary background to understand scientific talks and papers in broad areas of astrophysics, not just limited to their chosen subject;
2. to assess their capacity to perform fundamental research, and thus to become successful research scientists;
3. to assess students' ability to write a scientific paper.

The material covered during the exam includes work completed by the student during the two-quarter second year research project. It is advised that first year students identify a faculty advisor who is willing to oversee the project by the summer of the first year.

Exam Requirements

A student must satisfy the following requirements in order to be assessed for the comprehensive exam:

- Complete all nine core courses in Astronomy offered during the first 5 quarters and achieve a grade average of at least B.
- Exceptions or substitutions can be made by petition only, in advance, to the graduate advisor.
- Satisfactorily complete the two-quarter second year research project, by obtaining a passing grade in Astronomy 277A and 277B.
- Culminating in a written report which is given to the faculty advisor and to the members of the examination committee.

Exam Preparation

The students will meet with the Comp Exam Committee during the first half of winter quarter to go over the content and procedure of the exam. The students will have the opportunity to ask questions to the committee.

The Order of Magnitude Astrophysics course will normally be offered during the winter quarter preceding the exam. Students should take this course as an opportunity to ask questions about materials that was covered during colloquia and to practice order of magnitude estimates.

Astronomy Colloquia Slides will be collected and made available to the students, when possible.

Prior to the exam the students will work with their research advisor to prepare the research write-up according to the guidelines given below.

Assessment

Assessment will be based on three components:

1. A written report from the second year research project.
2. An oral research presentation of the content of the second year project.
3. An oral examination of general astronomy knowledge.

Each section will be found satisfactory or unsatisfactory independently from the other two sections. Passing the comprehensive exam requires satisfactory completion of each of these three components. More details on each component of the exam can be found below.

Written report: The student must prepare a written document detailing their work and results from the second year research project. If a paper has been published or is under review, the manuscript can be submitted as is. Alternatively, the paper should typically be between 3 and 5 pages in length in *Astrophysical Journal* format, and should be written in the style of an article published in a peer-reviewed journal. Under appropriate circumstances, a technical report in the format of a SPIE Proceeding is also acceptable. This document should summarize the work that the student has done as a part of the second year project, including any data reduction, analysis, results, and future prospects for the project. The written report must be given to the comprehensive exam committee no later than 3 weeks before the first date of that year's exams. Failure to turn in the paper by that time will result in failing the written component. The written component will be assessed based on the quality of the scientific writing, but should not contain typos or errors in basic grammar or syntax. The scientific writing should be clear and concise, demonstrate knowledge of the specific field of astronomy, include relevant details for the reproduction of the analysis, present and discuss results, and maintain a professional tone. Students are strongly encouraged to request feedback from their research advisors before the deadline. The committee will be cognizant of the fact that research projects don't always bear the anticipated fruit, or that unexpected equipment, data, or code problems can extend the timeline, but the written and oral reports should summarize the work as far as it was taken, including the motivations for the research and the anticipated outcome, and show that a concerted and well-informed effort had been made.

An important component of the assessment of the written report consists of input from the student's 2nd-year advisor. In addition to the grades for Astronomy 277A/B course (i.e., the course numbers assigned for the 2nd-year project), the committee will obtain a written assessment from each student's 2nd-year advisor regarding the student's progress and research achievements. In the event that the written report consists of a draft with additional co-authors, the advisor should define the specific contributions made by the student. This assessment will be solicited and obtained over email, in advance of the oral research presentations and general astronomy knowledge examinations during the spring of 2nd year. The purpose of this assessment is to communicate the 2nd-year advisor's opinion and information to the committee.

Oral research presentation: The student should prepare a slideshow presentation of the content of their second year project. This presentation should be 20 minutes in length without

interruption, with the expectation of an additional 15-25 minutes of questions about the project from the committee coming either during or at the end of the presentation. The style of the presentation should be that of a research talk at a conference or Journal Club. Students should be prepared to answer questions about the specific field of astronomy relevant to their project, the methods or procedures used, the results and their implications, and possible future work on the project. Students will be assessed based on how well they demonstrate knowledge of their own second year project and closely related fields of astronomy. More details are given below.

General astronomy knowledge exam: Students will undergo an oral exam of general astronomy knowledge. This exam consists of 45 minutes of questions from the committee that will be answered both orally and with work on the board. The material of the questions includes basic physics and astrophysics from undergraduate-level courses, topics covered in graduate courses taken up to the date of the exam, and general topics presented by speakers at the astronomy colloquia. Students will be assessed on their ability to demonstrate an understanding of a broad range of astrophysical topics, emphasizing understanding and problem solving over memorization. More details are given below.

Oral Examination Requirements

The oral portion of the exam consists of two components: a presentation on the second-year research project as described in the written report and a general knowledge exam. Both the research presentation and the general knowledge portions of the exam are weighted equally by the exam committee and diligent preparation should be applied to both. The full oral examination will typically take 90 minutes.

The research presentation should be at the level of a Journal Club or conference presentation. Thus, it should be concise, yet informative and as complete as possible. The essential purpose and results of the research should be clearly given. The student should prepare for 20 minutes and anticipate approximately 15-25 minutes of questions on the presentation or closely related issues.

The general knowledge portion of the exam should consist of 45 minutes of questions on general astronomical knowledge. Questions will typically be at the level of an undergraduate major general astronomy text such as Carroll and Ostlie's *An Introduction to Modern Astrophysics* but could cover topics from core graduate courses or modern topics such as those covered in the colloquia and journal club. The goal of the general knowledge section is to test **understanding not memory** and is meant to probe a wide variety of topics. Long derivations including complex formulae are avoided, but searching questions which probe the depth of a student's physical understanding of some phenomenon are appropriate. It is expected that students will not be able to correctly answer all questions and the committee will often provide direction if needed. To allow for a variety of questions, the committee may change topics when a student is struggling in order to fairly cover a wider range of material.

We recognize that past students have compiled a set of questions from previous years. These may serve as a useful study guide, but each year the committee is free to choose new questions and topics.

Possible Outcomes

The student will be assessed separately on each portion of the exam (oral research presentation, written research paper, and general knowledge). The committee will notify each student within 1 week *at the latest* the results of this assessment, giving specific feedback when possible. There are 4 ranked possible outcomes for the exam:

- **Pass:** the student is eligible to proceed to the qualifying exam and continue working towards the Ph.D.
- **Incomplete:** the student must retake the portions of the exam that were not satisfactory before they are eligible to continue working towards the Ph.D.
- **Terminal master's:** the student can finish any outstanding course requirements and then obtain a Master's degree, but is not eligible to continue to the Ph.D.
- **Fail:** this outcome results in a recommendation to the Graduate Division for termination of the student's affiliation with the department.

If the student receives an "incomplete" result, then the student must retake the portion(s) of the exam that were not satisfactory before the end of Week 1 of the following fall quarter. Within 1 week of receiving the "incomplete" result, the committee will meet with the student to discuss the reasons why they did not pass to help them prepare for retaking the exam. If the student passes the exam at the time of the retake, they are then eligible to proceed to the qualifying exam and continue working towards the Ph.D. The "incomplete" option cannot be applied more than once to any given student; therefore, the possible outcomes of the retake exam are limited to "pass" or "terminal master's." If a student chooses not to retake the exam after an "incomplete" outcome, they will be eligible to receive a terminal master's.

Reasonable Accommodations

Students needing academic accommodations based on a disability or chronic medical condition should contact the Center for Accessible Education (CAE) at (310) 825-1501 or in person at Murphy Hall A255. Students should contact the CAE at least two weeks before accommodations are needed. For more information, visit www.cae.ucla.edu.