

Faculty Guidelines to Ph.D. Qualifying Exam

Overview

To be allowed to continue in the Ph.D. program, by the end of their 2nd year all Ph.D. students are required to take and pass *a comprehensive defense of their Ph.D. thesis proposal*. The two hour twenty minute long oral exam is administered by the student's Ph.D. qualifying exam committee. During the first twenty minutes, the student presents their proposed Ph.D. dissertation research plan. In the remaining two hours the student defends the scientific merit of the proposal and their ability to accomplish the proposed research. In addition, they should be able to explain how their proposed thesis research fits in with current astronomical research and how it compares to related research. In other words, the student must demonstrate a thorough working knowledge of their proposed field of research *and* also of related fields.

Purpose

The purpose of the qualifying exam is to determine if the student is *qualified* to commence the dissertation phase of their Ph.D. program.

Qualifications to be met

The student must present and successfully defend a credible proposal for original research.

The student must demonstrate a competent (graduate) level of knowledge and understanding of astronomy in the area of research by successfully answering questions in the field of research.

The student must demonstrate a basic (undergraduate) level of knowledge and understanding in related fields of astronomy by successfully answering questions in fields of astronomy relevant to the research. The fields to be covered will be set by the examining committee at least three months in advance of the exam.

The student must demonstrate that they are familiar with the current literature in the field of their proposed research.

Preparation

- At least three months before the date of the exam, the supervisor, the student, and graduate coordinator select an examining committee consisting of the supervisor, and two fulltime faculty. Note that the thesis committee (also known as the supervisory committee), which is formed after the student commences their dissertation research, is a separate entity, although, in most cases the make up of the two committees will be the same.
- At least three months in advance of the exam the examining committee specifies the areas of astronomy open to examination. That is, they define the research field and related fields of the exam. This should be communicated to the graduate student and the graduate coordinator.
- In consultation with the student and the committee, the supervisor sets the date for the exam, reserves a room, and notifies the graduate coordinator.
- The committee appoints a chair (not the supervisor).

- At least *three* weeks before the exam, the supervisor ensures that their student distributes a written thesis proposal to the committee members. Note, the thesis proposal should be up to approximately 10 double-space pages in length plus additional figures, tables, and bibliography. Committee members should review the proposal immediately. *If they have any serious concerns they should be dealt with before the defense of the proposal* even if it means delaying the defense of proposal exam.

Exam Procedures

- The presentation is closed to all but those directly involved in the exam.
- The chair ensures that the exam is fair to the student and that the proceedings are conducted professionally without favoritism or prejudice. The chair controls the timing and discussion and ensures that the purpose of the exam (above) is maintained. Questions that fall outside the constraints defined under “purpose of the qualifying exam” should be given significantly lower weight.
- The student has a maximum of 20 minutes to orally present their proposed research plan. If necessary the chair should interrupt and stop the student immediately after the allotted time.
- Following the presentation by the student the student answers questions from the committee about their proposed research, their research field, and related fields.
- The total exam duration should not exceed two hours 20 minutes, that is, 20 minutes maximum for the proposal and 2 hours maximum for the question period.
- The structure of the exam is controlled by the chair and should be agreed upon by the committee. An example of a reasonable structure consists of 20 minute presentation, round 1 with 20 minutes of questions from each of the three examiners directly related to the proposal, followed by round 2 with another 20 minutes of questions from each of the three examiners on the field and related fields.
- The supervisor is not permitted to assist the student in any way during the exam even if the questions themselves are poorly posed and/or their presumption is known to be false. Only the chair may intervene on the student's behalf.
- Problems with the research proposal itself can be identified, but time should not be spent trying to resolve them.
- While they have the floor, other members should not interrupt or interfere. Incorrectly posed or inappropriate questions should be discussed by the committee after the exam. Only the chair may intervene if they feel the student has clearly misunderstood the question, or that the examination time is being wasted, or that the question does not serve the purpose of the qualifying exam.
- We recommend that each member of the committee keep a brief record of the questions asked and their rating of the responses by the student. This is a public record to be used as evidence of accountability should the need arise. It should be kept short with just a couple of words used to note each general area of questioning by each examiner, along with a P (pass) or (F) fail. Personal comments, notes, or reminders should be made in a separate document, which is kept private. Here is an example of the public record from one examiner:

Round 1

Kracker asked: absorption line definition (P); broadening mechanisms (P); abundances (P); how produce C and O (F).

Kringle asked: Hubble's constant definition (P); Freeman topology (P); Microwave blackbody radiation cause (F).

- Following the final round of questions the chair asks the student to leave and wait for the results in the student's office.

Evaluation and Outcome

- The chair invites each member in turn to discuss *their* evaluation of the student's performance.
- The following questions should be considered:
 - Does the student understand the project?
 - Does the student have a reasonable grasp of the background material, enough to begin the project?
 - Is the project itself well defined and reasonable and if not how should it be improved? Does the project constitute original research and is it likely to lead to a defensible Ph.D. thesis?
 - Is the student qualified to undertake the research?, I.e., does the student have sufficient knowledge and understanding in the field of research, its literature, and related fields to undertake the research competently?
- After the discussion, the chair asks each member to cast a vote of pass—the student is qualified to undertake the research, or fail—the student is not yet qualified to undertake the research.
- The student passes when a majority of the committee passes the student. The student fails when a majority of the committee fails the student.
- The chair should immediately report the outcome of the exam to the graduate coordinator.
- If the student fails the exam then the student is offered one opportunity to retake the exam. If the student declines they will be asked to leave the program immediately.
- The proposal itself can be approved (no further action is required) or approved with minor modifications (supervisor sees that the recommend modifications are made). If major modifications are required then the student is considered to have failed the exam.
- The committee members should keep their public record of evaluations on file for at least one year.

Retake Guidelines

- If the student fails the first exam, then a new exam of two hours duration should be scheduled no later than three months following the initial exam. The student only has to redo their presentation if the committee decides it is necessary. In which case, the duration of the exam should be extended by 20 minutes. The supervisor is responsible for the rescheduling and should notify the graduate coordinator when the date is set.

- If the student fails the retake then the student will be asked to leave the program immediately.

Exam Question Guidelines

- It is the responsibility of each committee member to come to the exam well prepared with a diverse selection of appropriate questions. It is recommended that the committee members confer with each other before the exam to ensure that their questions are sufficiently diverse.
- Examiners should be sensitive to students who are overly nervous or are non-native English speakers and should make allowances if they can. For example, one could start with easier definition type questions before moving onto more challenging tests of the student's understanding.
- Questions should vary in difficulty level, ranging from simple definitions, e.g., what is a color index, through deeper levels of understanding, e.g., why do some color indices depend on temperature, to expert level questions, e.g., how would you go about designing and calibrating a new color filter system.
- Extra consideration and sensitivity should be given to the student when asking graduate level questions. Consider if your fellow faculty can answer the questions. Questions should be restricted to areas that you know the student covered in their core graduate level courses **and** that are related to their proposed research.

Example Questions

The examining committee members do not need to be experts in the field. They are to examine the integrity of the science of the proposal and assess whether or not the student is prepared to undertake the proposed research.

Thesis Topic: Asteroseismology of Red Giants Constraining Convection

Field: Asteroseismology

Related Fields: Stellar Structure and Evolution; Stellar observables (parallax, colours, magnitudes, space motions, composition)

Examples of Expert Questions:

What are p -modes and what are g -modes? What causes pulsation in solar type stars? What are the differences in pulsation between solar-type stars and red giants? How are the oscillations observed and their frequencies determined. How does convection affect the structure of the star? Show to scale the cross section of the interior of a red giant, indicating convective regions and nuclear burning regions.

Examples of Proposal Defense Questions:

You cite the paper, NNN, in your proposal. Can you tell me what they did? What can asteroseismology tell us about red giants and why should I care? Is anyone else working on your problem? I do not understand what you mean by "determining the depth of the tacholine" can you explain what tacholine is and how exactly you determine its depth? The BBC web site last week had an article on planets around giant stars, how does this relate to what you propose to study?

Examples of Related Field Astronomy Questions:

What is a red giant? How do we distinguish observationally a red giant from other stars...that are red? Do all stars become red giants? What other types of stars are there for which you can do asteroseismology? What causes convection in stars? Draw an HR diagram, label the axes, and show the main sequence. Show the location of the Sun and Vega (A0). What is the surface temperature of the Vega an A0 star? What does its stellar spectra look like compared to the Sun? What causes absorption lines? Can you see helium absorption lines in red giants? Blue giants?