

# A Guide to Graduate Studies in Astronomy and Astrophysics

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## 1 LIVING DOCUMENT (VERSION 0.9):

- The Field will routinely update this document and increment the version number and date.
- Some parts may be moved online and incorporated by reference so that the Handbook's text will require less frequent updates. At the moment links, lists, figures, etc. are fully included and the document is self-contained.

## 2 PH. D. IN ASTRONOMY AND SPACE SCIENCES

### 2.1 LEARNING GOALS:

The program's goal is to provide the foundation for a professional career in Astronomy, Space Sciences and/or an allied quantitative discipline. The first two years of education are directed towards acquiring a broad and inclusive scientific knowledge of the field of Astronomy and Space Sciences through classwork, seminars, colloquia and interaction with faculty. Experience is gained in communicating ideas verbally and in written form. This education will support diverse possible careers situated in academic (research, teaching) and non-academic settings (public interest, governmental, industrial). The program's focus narrows in the third year as students begin full-fledged research, solving new problems and acquiring deep knowledge in specific areas. Through the remainder of the graduate program, participants hone their professional scientific skills and carry out original, publishable research.

## 2.2 GRADUATE STUDIES AT CORNELL:

Graduate students occupy a special niche at Cornell. While undergraduates may be enrolled in one of the several Colleges, *all* graduate students are attached to the Graduate School. The Graduate School functions as an administrative center, issuing policies and requirements governing all fields.

See §12 for abbreviated definitions of some terms frequently used in this handbook. The website <https://gradschool.cornell.edu> presents the general description of the Graduate School. The Code of Legislation is the comprehensive formal description of the Graduate School rules common to all fields and found at <https://gradschool.cornell.edu/policies/#results>.

Each enrolled graduate student is admitted to a particular field. A field is a voluntary grouping of faculty with common academic interests. Fields are independent of traditional college or department units and draw together faculty members from several colleges, departments, and related disciplines in accordance with scholarly interests. Astronomy and Space Sciences is one of 96 fields at Cornell. The field adds supplementary field-specific rules to those stipulated by the Graduate School. This handbook outlines the current situation for graduate students in Astronomy and Space Sciences and provides useful information on prospering in the program.

## 2.3 VALUES STATEMENT:

The shared pursuit of astronomical knowledge brings researchers, faculty, students, and staff members together as the Cornell Astronomy community. Our community thrives when its members feel respected and supported. As detailed in our Values Statement <https://astro.cornell.edu/values-statement> we aim to create an environment promoting respect, communication, diversity and inclusion, professionalism, and mentorship.

# 3 STRUCTURE OF THE PROGRAM:

## 3.1 OVERVIEW:

Advancement through the program is illustrated in the accompanying Fig. 3 which highlights milestones, research activity, courses, teaching and outreach. The milestones represent important time-sensitive goals (exams, choice of thesis advisor, formation of Special Committee, graduation). The research and course entries describe the two primary scholarly activities undertaken by every student in the Ph. D. program. Teaching and outreach entries suggest time frames for undertaking activities that build skill in these important areas. Progress is linked to successfully navigating the program goals within certain time frames (see §4 for metrics of progress).

### 3.1.1 FINANCIAL SUPPORT:

In the Ph. D. program graduate students are supported by a combination of teaching assistantships, fellowships (internal and external) and research grants. Typically, new students work as teaching assistants first and then join research groups. All students that are eligible to

# Graduate school timeline



	First Year	Second Year	Years 3/4	Years 5/6
<b>Milestones</b>	Meet First Year Committee 1-2 times per semester Q-exam	Form Special Committee with advisor as chair	A-exam (typically 5 <sup>th</sup> semester): Transition from MPhil to PhD)	Apply for jobs.  B-exam and you're done!
<b>Research</b>	Investigate research opportunities/advisors Research full-time during summer.	Research increasing fraction of time.	Full time research publishing, collaborating presenting, formulating thesis	Complete thesis projects, publish, present.
<b>Courses</b>	Typically take 3 courses per semester. Usually core physics and astronomy courses	Take 3 courses per semester. Advanced and applied/ specialized courses.	Courses as wanted/needed.	
<b>Teaching</b>	Typically gain teaching experience at some point during first two years.		Options to grade for non-intro classes for extra \$	Apply for Buttrick-Crippen Fellowship?
<b>Outreach</b>	Opportunities for public outreach ( e.g. Ask an Astronomer, AfterSchool Universe ...)			

do so are encouraged to apply for external fellowship support. The Field guarantees funding support through a mix of the funding sources listed above for a period of 6 years for students making acceptable timely progress toward the Ph. D.

### 3.1.2 MILESTONES:

Most entering students begin by taking various foundational classes the first academic year (see §5 for a general description of classes offered, expectations of number of classes, <https://www.overleaf.com/project/> etc.). During the Fall and Spring semesters students should make a concerted effort to meet the faculty and explore research opportunities (attending seminars, colloquia and journal clubs) and to locate a full-time summer research project with a potential thesis advisor.

All students take the diagnostic Qualifying exam at the end of the first summer (see §6.1 Q exam). During the second academic year students generally take some advanced classes and do some research but the breakdown of effort will vary depending upon the area of specialization, previous research experience and overall academic background. Once the Q exam is passed and any consequential committee recommendations are attended to the student will aim to assemble a permanent special committee (see §3.1.3 for a description of the Cornell special committee system).

All students admitted to the Field of Astronomy and Astrophysics have considerable freedom in their choice of research area and faculty member. Selecting and assembling a permanent special committee implies that the student has chosen a general area for research, located a faculty member willing to serve as thesis advisor and decided upon minor members (the DGS provides one additional member). Many students form the committee in the late Fall of their second year which is realistic and feasible if the plan is to continue to work on research started during the summer; others seek a new, suitable research group. Students are free to switch from one area to another *before* the formation of the permanent special committee. The Field encourages those who are conflicted about continuing with one advisor or switching to a new advisor to consult their First Year Committee and/or the DGS as soon as possible. The Graduate School requires the permanent committee be formed by the beginning of the fifth semester.

The permanent special committee guides the student through the rest of the program. It also administers the A and B exams, the major milestones for the program. The A exam (Admissions to candidacy, §6.2) checks the student background in the proposed research area and marks the point after which effort is largely devoted to the thesis subject. The Cornell Graduate School requires taking and passing the A exam within 3 years of entry to the program (before the beginning of the 7th semester). The Field recommends not delaying and, in fact, most students take the A within a year of forming the permanent special committee (the 5th semester). The B exam (the Ph. D. defense, §6.3) is the final hurdle and the degree is awarded when it is passed and the thesis approved. The actual time from entry to exit is about 6 years; the Cornell Graduate School requires completion within 7 years although petitions to extend may be granted in special cases.

### 3.1.3 SPECIAL COMMITTEES:

In the Graduate School a special committee guides the student during the entire time the student is enrolled in the program. In this Handbook there are *two types of special committees*. On matriculation each new student is assigned a *First Year Committee* comprising four individuals purposefully drawn from a wide variety of subject areas. The Director of Graduate Studies (DGS) is an ex-officio member. The arriving student meets the committee at the beginning of the Fall semester and at least once per semester thereafter. The committee provides advice on courses, research, graduate school and career. The First Year Committee helps the student navigate the program until the *permanent special committee* replaces it, once the Q exam is passed and a chair selected. If the entering student has well-defined research interests a single faculty member from the First Year Committee or from the faculty may be assigned as the incoming student's primary mentor along with the DGS but the entire First Year Committee monitors and assesses all the students in a given year.

The chair of the permanent special committee is the thesis advisor, the student's main mentor during the Ph. D. program. Students will often informally name a secondary advisor for theses that are broad in scope or for other reasons; the field encourages but does not require this informal arrangement. The typical committee is composed of the thesis advisor, two minor members and one Field-appointed member. Each committee member represents an area of study<sup>1</sup>. The area represented by the chair of the committee is the student's major subject, one of the concentrations in the Field. The areas represented by the two minor members are the student's minor subjects. These committee members (excluding the Field-appointed member) represent three separate areas.<sup>2</sup>

There are many possible variants for committee membership easily implemented when the committee is first being formed. A few are described below. Some must be approved by the DGS and Graduate School so it is strongly recommended that the student consult the DGS when variations are contemplated.

(1) Students may request that an individual who is not a member of Cornell graduate faculty be appointed as an ad hoc member of the special committee. The chair is someone from the general graduate field and the ad hoc member is a minor member.

This may be appropriate, for example, if the student's thesis research involves a close collaboration with a non-faculty research staff member at Cornell, or a faculty at another institution.

(2) Minor members may be drawn from field(s) other than Astronomy and Space Sciences. A minor member from outside the field represents a new subject or concentration and stipulates the specific requirements the student should fulfill for that minor.

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<sup>1</sup>Each graduate field is composed of a small number of subjects of study. Subjects are broad categories. For many of the 96 fields at Cornell there is one subject which is identical to the field itself. Each subject may be sub-divided into specialized areas, which are called concentrations. In Astronomy and Astrophysics the field and subject are equivalent and there are only concentrations. In other fields there may be both subjects and concentrations.

<sup>2</sup>It is generally not difficult to identify 3 separate areas covered by the major and minor members when all the members are drawn from the Field of Astronomy and Space Sciences. As we see below, a minor member may be from Physics or an allied field and there is never a practical difficulty satisfying the requirement of 3 separate areas. If this is ever problematic, consult the DGS.

This may be appropriate when research involves subjects or concentrations of two Graduate School fields. It is strongly recommended that the student consult the appropriate DGS to review general expectations for minors in that field.

(3) The committee can have two co-chairs, one minor member and one Field-appointed member. A co-chair has the same rights, responsibilities, and obligations as a single special committee chair; both co-chairs must fulfill all chair requirements.

This committee structure may be appropriate if the research plan and/or graduate learning experience relies upon the direction provided by two specific individuals. Nothing precludes any student from seeking advice from a second faculty member as an informal secondary advisor if the committee has a single chair; but if the thesis plan is to work with two individuals then a committee with co-chairs may provide the best fit. In this case, the student has two mentors. The committee still has 4 members including one minor member and one field appointed member.

The permanent special committee directs the graduate education and administers the A and B exams. Changes before the A exam are done online and merely require the approval of all the members of the newly constituted committee. Changes after the A exam are not allowed except by petition to the Graduate School. If the change involves a substantial change in research subfield it may necessitate a new A exam.

#### 4 METRICS FOR PROGRESS

Milestones mandated by the Graduate School include formation of permanent special committee and completion of A and B exam within various time deadlines. "Good academic standing in the Graduate School" means all applicable milestones have been achieved, or petitions to extend the corresponding deadlines have been approved. In addition, for students in the 2nd year in the program and each year thereafter, the Graduate School requires that the annual Student Progress Review (see below) be completed. The Graduate School may impose holds on registration of students missing these deadlines, which may lead to loss of student status (including visa status for international students) and loss of eligibility for financial support such as TA and GRA appointments or disbursement of fellowships.

The Field of Astronomy and Space Sciences adds completion of the Q exam which must be taken at the end of the summer of the first year.

To be considered in good academic standing by the field, students who have not yet formed their permanent special committees should also maintain a full-time academic schedule. For students not involved in research, this means taking a full-time course load. The number of regular (3 or 4-credit) courses per semester considered to be full-time is two, if supported as a Teaching Assistant, or three, if supported by a Fellowship. Classes taken pass/fail (S/U) and audits do not count towards this requirement. The minimum required grade is B-. The coursework should be relevant for a Ph. D. During the transition from coursework to full-time research, the number of courses taken should decrease in concert with the increase in time devoted to directed reading or research. Roughly, students should expect to spend 15-20 hours per week on such activities for each one- course reduction in the course load. The DGS or special committee chair may contact the faculty supervising reading or research to confirm

that the full-time academic schedule requirement is being met during the transition.

First- and second-year students failing to maintain a full-time schedule or minimum grade requirements should expect to be asked to discuss the situation with the DGS and their First Year Committees and find ways to improve. If the situation does not improve over time, the student may lose eligibility for financial support.

Once a permanent special committee is formed, the student's level of effort and rate of progress towards Ph. D. should meet the expectations of the committee chair/research advisor. Students and advisors need to discuss such expectations on a regular basis. The special committee must meet at least once per academic year and ideally once per semester. In case of disagreements, the DGS should be contacted and will facilitate the conversation. The advisor's approval of the Student Progress Review constitutes a formal indication that the expectations are being met.

Since timely progress is important the program automatically extends all deadlines by one semester for each semester of official leave. The various leaves (In Absentia Leave, Personal and Health Leaves of absence) are summarized at <https://gradschool.cornell.edu/policies/leaves-of-absence>.

The Graduate School requires that each student in their second year and beyond complete a Student Progress Review (SPR). Each student will receive a link, along with specific instructions and deadlines, from the DGS regarding the SPR each year. Typically, students will complete the SPR near the end of May each year. Upon receipt of the instructions from the DGS, each student should schedule a meeting with their advisor (special committee chair) to review the SPR. The student should then follow the link to complete their SPR form and submit it for review by the advisor at least a week in advance of the meeting. The SPR is designed to facilitate discussions between student and advisor on research progress, career planning, and mentoring. After amending the SPR form based on the advisor meeting, the student will electronically submit the form. The advisor will then approve/comment on the form electronically, and submit it to the DGS and Graduate School.

## 5 COURSE GUIDELINES

The Field of Astronomy and Space Sciences has no specific required courses and no foreign language requirements. Students are expected to follow the suggestions made by their special committee. Generally graduate classes may be approved by the committee in any appropriate and relevant area. Undergraduate classes are acceptable for remedial purposes if needed.

Students should aim to take foundational classes (sometimes referred to as core areas) before more specific narrow offerings. The following subsections help students find the most appropriate classes. The principle is *The student takes the most widely recommended classes in the concentrations of greatest individual interest*. Note: because not all classes are offered every year flexibility is required. In all cases, students should make their course selections after consulting their special committee.

The normal course load for first year students not engaged in research is 2 classes/semester for those TAing and 3 classes/semester for those on fellowships. Here a class means a regular 3 or 4 credit course. During the ramp up to full-time research, the course load should decrease.

Roughly speaking, students should expect to spend 15-20 hours per week on research or directed reading for each one-course reduction in course load.

The general expectation is that students will complete a minimum of 8 courses within their first 3 years with grades of B- or better excluding SU classes and seminars. Due allowance will be made for those who complete the A exam ahead of schedule and for those who enter with extensive course backgrounds (e.g. a Master's).

The Cornell Graduate School and the Department of Astronomy also offer a variety of professional development classes (see sections that follow). Students are encouraged to pick and choose useful classes but note that most do not provide credit hours or grades.

To gain a broad perspective students should attend all departmental colloquia, seminars relevant to their field of interest, coffee hour and arXiv discussions. Discussions with colleagues and keeping up with scientific literature are essential. Experience in teaching, presenting in seminars and undertaking outreach are all encouraged.

## 5.1 CONCENTRATIONS IN THE FIELD

Concentrations reflect various scientific interests within the Field of Astronomy and Space Sciences. The faculty decide upon a set of concentrations and each faculty member selects a subset to describe his or her own interests. The list of concentrations and the list of faculty interests is found at <https://gradschool.cornell.edu/academics/fields-of-study/field/astronomy-and-space-sciences/>.

The current list of concentrations is:

- astrobiology
- astronomy
- astrophysics
- astrostatistics
- cosmology
- data science
- exoplanets
- instrumentation
- planetary sciences
- space sciences [general]
- theoretical astrophysics

The meaning of these terms is as follows:

The most general categories from which the Field derives its name, Astronomy and Space Sciences, are:

1. Astronomy - The general field of natural science concerned with celestial objects including Solar System, Galactic and Extragalactic objects. Most of the enrolled students in the field work in this overarching area.

2. Space Sciences [general] - Scientific disciplines involving space exploration and phenomena taking place in space. Students involved with space missions and the exploration of the Solar system work in this area. Many enrolled students in the field are engaged in this area.

To these general categories the Field adds more specific ones (alphabetically):

3. Astrobiology - The subfield concerned with the origin, evolution, distribution and future of life in the Universe. It comprises both observational and theoretical studies of the possibilities for life in the Universe.

4. Astrophysics - The application of physics and related sciences to explain natural phenomena in the general field of Astronomy. Students that engage in substantial quantitative research in Astronomy generally work in this area.

5. Astrostatistics - The subfield concerned with the analysis of data (relevant to Astronomy and Space Sciences) by the methods of statistics, data mining and machine learning.

6. Cosmology - The description of the Universe on large scales. Students that study the history and development of large scale features of the Universe like groups and clusters of galaxies and the cosmic microwave background are engaged in this area. The field also probes questions of fundamental physics via astronomical/astrophysical studies.

7. Data Science - The subfield concerned with the development of algorithms, computing methods, statistical techniques for the purpose of exploring data sets (relevant to Astronomy and Space Sciences).

8. Exoplanets - Study of planetary systems outside the Solar System. Students study the origin, evolution and observational properties of planets and host stars beyond the Solar System. The notion of planet includes not only the solid part but also the atmosphere.

9. Instrumentation - The design and construction of instruments to measure and record physical properties (in Astronomy and Space Sciences). It includes laboratory studies to develop ground, air-borne and space-based instruments.

10. Planetary Sciences - Quantitative science of Solar System and bodies in orbit about other stars including moons, rings, asteroids and comets. Students that analyze data from space missions are engaged in this area.

11. Theoretical Astrophysics - The mathematical modeling of natural phenomena in Astronomy and Astrophysics. Students that calculate model outcomes by simulating or solving the relevant physical laws are engaged in this area.

## 5.2 PRACTICAL USE OF THE CONCENTRATIONS

Students may find it helpful to approach faculty members for possible research projects based on the concentrations.

There are no specific course or credit requirements for the subject concentrations. In addition, courses are not specifically aligned with the concentrations. Nevertheless, students who are interested in a particular concentration should consult Table 5.2 below which shows the courses that are typically suggested by the faculty and students involved in each area.

Course #	Course Name	When offered (typically)	All Concentrations	Astrobiology	Astrophysics	Astrostatistics	Cosmology	Data Science	Exoplanets	Instrumentation	Planetary Sciences	Theoretical Astrophysics
A6509 / PHYS 6553	General Relativity I	Fall										
A6510 / PHYS 6554	General Relativity II	Spring										
A6511	Physics of Black Holes, White Dwarfs, and Neutron Stars	Fall										
A6516	Galactic Structure and Stellar Dynamics	Spring										
A6523	Modeling, Mining and Machine Learning in Astronomy	Spring										
A6525	Techniques of Optical/Infrared, Submillimeter and Radio Astronomy	Fall										
A6530	Astrophysical Processes	Spring										
A6531	Astrophysical Fluid Dynamics	Fall										
A6560	Theory of Stellar Structure and Evolution	Fall										
A6570	Physics of the Planets	Spring										
A6575	Planetary Atmospheres	Fall										
A6577	Planetary Surface Processes	Spring										
A6578	Planet Formation and Evolution	Spring										
A6579	Advanced Astrodynamics	Spring										
A6590	Galaxies and the Universe	Fall										
A6599	Cosmology	Fall										
A7340	Symbolic and Numerical Computing	Spring										
A7671	Topics in Planetary Atmospheres	Fall										
A7690	Computational Physics	Fall										
A7883												
CHEME 5740	Probability, Statistics, and Data Analysis for the Physical Sciences	Fall										
CS 5768	Machine Learning for Data Science	Spring										
EAS 4580	Volcanology	Spring										
EAS 5041	Geodynamics	Fall										
EAS 5840	Inverse Methods in the Natural Sciences	Fall										
PHYS 6561	Classical Electrodynamics	Fall										
PHYS 6562	Statistical Physics I	Spring										
PHYS 6572	Quantum Mechanics I	Fall										
PHYS 6574	Applications of Quantum Mechanics II	Spring										
PHYS 7651	Relativistic Quantum Field Theory I	Fall										
PHYS 7652	Relativistic Quantum Field Theory II	Spring										
PHYS 7680	Computational Physics	Fall										
STSCI 5080	Probability Models and Inference	Fall										
			Highly Recommended		Recommended							

Figure 5.1: Course Recommendations by Concentration

Classes that are recommended across related subject areas are considered foundational. Classes that are helpful in particular concentrations are checked.

The online version is at <https://tinyurl.com/y8zgtgjm>.

### 5.3 COMPENDIUM OF HISTORICALLY INTERESTING CLASSES

Table 5.3 gives a large list of classes taught within the Astronomy Dept. and allied Depts. of interest to graduate students in the field, organized alphabetically by Dept. and course number. Note that many classes are given only every other year, many are given in two departments,

### 5.4 SPECIFIC FIELD PROVIDED CAREER AND PROFESSIONAL DEVELOPMENT

The Dept. of Astronomy has introduced two specific classes that are especially relevant to graduate students in Astronomy and Space Sciences: Prof. Nikole Lewis leads a no-credit class

Course No.	Alt. No.	Title
A6509	P6553	General Relativity
A6510	P6554	Applications of General Relativity
A6511	P6525	Physics of Black Holes, White Dwarfs, and Neutron Stars
A6516		Galactic Structure and Stellar Dynamics
A6523	A4523	Modeling, Mining & Matching Learning in Astronomy
A6525		Techniques of Optical/Infrared, Submillimeter and Radio Astronomy
A6530		Astrophysical Processes
A6531		Fluid Dynamics
A6555		Interstellar Medium
A6560	P7667	Theory of Stellar Structure and Evolution
A6570		Physics of the Planets
A6575	EAS5750	Planetary Atmospheres
A6577	EAS5770	Planetary Surface Processes
A6578	EAS5780	Planet Formation & Evolution
A6579	MAE6720	Celestial Mechanics
A6590		Galaxies & the Universe
A6599	P6599	Cosmology I
A7340	A3340	Symbolic and Numerical Computing
A7671		Topics in Planetary Atmospheres
A7672		Seminar series (not sure if this is still on the books)
A7683		Seminar: Astronomy & Planetary Science
A7690	P7680	Computational Astrophysics
A7699		Seminar: Theoretical Astrophysics
BIOMG3300		Principles of Biochemistry, Individualized Instruction
BIOMG3310		Principles of Biochemistry: Proteins and Metabolism
BIOMG3320		Principles of Biochemistry: Molecular Biology
BIOMG4320		Survey of Cell Biology
BIOMG6310		Protein Structure and Function
BIOMG6330		DNA Biology
CHEM7960		Statistical Mechanics
EAS4530		Mineralogy
EAS5041		GeoDynamics
EAS5051		Climate Dynamics
EAS5880		Advanced Method in Radar
P6561		*Electricity and Magnetism
P6562		*Statistical Physics I
P7653		Statistical Physics II
P6572		*Applications of Quantum Mechanics I
P6574		Applications of Quantum Mechanics II
P7635		Solid State Physics I
P7635		Solid State Physics II
P7645		Particle Physics I
P7646		Particle Physics II
P7651		Relativistic Quantum Field Theory I
P7652		Relativistic Quantum Field Theory II
P7661		Advanced Topics in High-Energy Particle Theory

Table 5.1: Relevant Courses

in the Fall on writing fellowship applications and Prof. Nick Battaglia teaches a one-credit seminar (A7683 Astronomy & Planetary Science) designed to introduce students to how to read/present/write about a range of scientific topics.

## 5.5 GRADUATE SCHOOL PROVIDED CAREER AND PROFESSIONAL DEVELOPMENT

The Cornell Graduate School offers a suite of academic, career, professional, and personal development programs that students are encouraged to explore. These are general, suitable for students across the entire graduate school and cover all phases of the student journey from learning how to navigate graduate school to identifying and applying for jobs.

The current offerings include:

- Career Development:

<https://gradschool.cornell.edu/career-and-professional-development/>

- Future Faculty and Academic Careers:

<https://futurefaculty.cornell.edu/>

- Careers Beyond Academia:

<https://gradcareers.cornell.edu/>

- Career Services:

<https://www.career.cornell.edu/students/grad/index.cfm>

- Pathways to Success:

<https://gradschool.cornell.edu/career-and-professional-development/pathways-to-success/>

- Events and Workshops:

<https://gradschool.cornell.edu/events/>

- Academic Success:

<https://gradschool.cornell.edu/academic-progress/office-of-academic-and-student-affairs/>

- Inclusion and Student Engagement:

<https://gradschool.cornell.edu/diversity-inclusion/>

- Personal Development:

<https://gradschool.cornell.edu/student-experience/student-life-programs/>

- Big Red Barn:

<https://gradschool.cornell.edu/student-experience/big-red-barn/>

- Postdoctoral Studies:

<http://postdocs.cornell.edu/>

## 6 EXAMS: Q, A, B AND MASTER'S

### 6.1 Q EXAM

The Qualifying Exam (Q Exam) is required by the Field of Astronomy and Space Sciences. It is a diagnostic exam held towards the end of the summer of the first year. There are three inputs: the student's written report in the format of a journal letter or paper discussing the summer's research, the supervisor's written report on the summer's research experience and an oral examination conducted by the First Year Committee.

The student written report is used to assess written scientific communication and initial progress in research. The First Year Committee reviews the supervisor and student reports to understand the student's future direction in the program.

The oral part of the exam tests the student ability in 5 areas: (1) depth of knowledge in core astronomy and relevant physics topics gained either as a senior undergraduate or in the first year of the graduate program, (2) familiarity with broad astronomical research as can be gained from colloquia, seminars and papers in the scientific and general press, (3) order of magnitude reasoning and back of the envelope calculations at the level of astronomy and physics undergraduate problems, (4) use of reasoned arguments and degree of clarity of oral discussions with the committee, (5) formation and presentation of a brief overview (elevator talk) of summer research. Here the format is limited to a blackboard overview of 5-10 minutes without prepared slides.

The oral exam involves all the members of the First Year Committee to ensure consistency and divorce the exam from a research-area specific assessment. The DGS attends and monitors the proceedings. The prospective chair of the permanent special committee may attend the oral exam to support the continuity in mentoring of the student but is not a committee member and does not answer questions on the student's behalf. The First Year Committee reviews the student's performance in courses and summer research in addition to the performance in the oral exam.

The First Year Committee meets with the student at the end of the oral exam to briefly (1) give their assessment of the overall performance in terms of breadth and depth of core knowledge relevant to the Field Ph. D. program, (2) highlight any areas of concern/weakness and what steps should be taken to address these, (3) makes recommendations to ensure successful progress in the coming year.

The Q exam has three possible outcomes: (1) The Committee passes the student. (2) The Committee requests that the student retake the oral exam during the 3rd semester if the student did not perform adequately. (3) If the Committee has significant concerns after the assessment it may suggest the student complete the Master's rather than continue towards a Ph. D.

When the Committee passes the student it will generally recommend (1) the student form a permanent special committee, (2) embark on the chosen research area, (3) continue to develop the depth and breadth of knowledge and communication skills necessary to support the research.

The outcome and feedback is summarized in a formal letter to the student, a copy which will kept in the student's file.

## 6.2 A EXAM

The Cornell Graduate School requires every student pursuing a Ph. D. take the Admissions to Candidate exam. The exam assesses readiness to carry out thesis research. It may be taken after two semesters are completed and must be taken before the beginning of the seventh semester.

In the Field of Astronomy and Space Sciences the exam may only be scheduled after the Q Exam is passed and the permanent special committee formed. The thesis advisor helps the student decide when enough background reading/research in the proposed thesis area has been completed to take the exam. Students who are pursuing outside minors should make sure that they have completed a substantial part of the work required by the minor field.

The A exam is an official University exam which requires that paperwork (Schedule of A Exam form) be filed with the Graduate School at least one week before the exam is to take place. All committee members commit to the time and place of the exam on the A form. Because it is often difficult to assemble 4 faculty at one time and place the student is advised to file the official form a month or more before the exam.

The A exam is administered by the student's permanent special committee. The format of the exam is flexible but generally comprises an oral presentation of research results achieved so far and an outline of the thesis research that is planned. During the exam the committee asks questions that probe general comprehension of the material and specifics of the research. In all cases, the student and committee members should discuss the parameters of the exam ahead of time, so there is a clear understanding of requirements and expectations.

The A exam has three possible outcomes: (1) Pass, the student is formally admitted to Ph. D. candidacy. The committee may recommend the award of a Master's degree without thesis as an in-progress degree. (2) Pass at the Master's degree level. The student may not continue to Ph. D. The special committee may recommend the award of a Master's degree without thesis as a terminal degree; or it may recommend that the student start work on a Master's thesis which should be completed in a timely manner (normally before the end of the third academic year of graduate work). (3) In rare circumstances, the special committee may ask the student to retake the exam. The committee will determine the parameters of the retake in consultation with the DGS, and communicate them clearly to the student.

The A exam results are filed with the Graduate School.

## 6.3 B EXAM

The student's research culminates in a written document (the thesis or dissertation). Its scope and content is agreed upon by the student and special permanent committee and its form is subject to general formatting requirements of the Graduate School <https://gradschool.cornell.edu/academic-progress/thesis-dissertation/writing-your-thesis-dissertation/formatting-requirements>. A draft thesis, acceptable to the committee, is required to schedule the final Ph. D. Exam (B exam).

The acceptable form of the thesis or dissertation has evolved over the years in some fields. In the past it was often a monograph starting with a literature review and continuing with new research results. Now, however, a "papers option" for the thesis is available in

many fields including Astronomy and Space Sciences <https://gradschool.cornell.edu/academic-progress/thesis-dissertation/writing-your-thesis-dissertation/fields-permitting-> Here, the thesis is organized as a series of relatively independent chapters or papers that have been or will be submitted to journals in the field. The Graduate School requires that the student must be the only author or the first author of the papers to be used. The document must meet all format and submission requirements, and a singular referencing convention must be used throughout.

The Cornell Graduate School requires every student receiving a Ph. D. take the B exam. It is an oral exam conducted by the student's special permanent committee based on the draft thesis. All other prescribed work must have been completed. The student gives a public talk lasting approximately 1 hour, followed by a closed door session with the special committee. The exam is limited to the thesis and related subject matter.

The B exam is an official University exam which requires that paperwork (Schedule of B Exam form) be filed with the Graduate School at least one week before the exam is to take place.

Understanding the steps and associated deadlines in the thesis/dissertation submission, B exam and degree conferral process is necessary to establish a realistic time frame. The checklist <https://gradschool.cornell.edu/academic-progress/thesis-dissertation/writing-your-thesis-dissertation/understanding-deadlines-and-requirements/> should be consulted.

Based on the timelines discussed above the Field of Astronomy and Space Sciences strongly recommends that the thesis be circulated to the student's special committee, in a form already suitable for submission, six weeks in advance of the B exam. The DGS signs the scheduling form and submits it to the Graduate School only when this has occurred. The student should include the Graduate Field Assistant in the distribution list.

The Graduate School requires that public notice of the exam be posted a minimum of 7 days in advance of the exam. The student works with the Graduate Field Assistant to prepare a poster with suitable picture or illustration no less than one week before the exam to advertise a public talk. The poster is displayed in Space Sciences Building and other relevant locations. The poster must clearly state that it is a B Exam or Ph. D. defense and include the student's name, the advisor's name, the title of the talk, the date, time, location and abstract.

The oral B exam is conducted by the special committee after the public talk.

After the student passes the B exam the special committee typically asks for a limited number of final changes to the draft thesis document, withholding final approval of the thesis until all edits are done. The student makes the changes and submits the thesis document to the electronic thesis/dissertation service (ProQuest) and the committee gives its final approval. The Graduate School grants the Ph. D. at the next University conferral date, typically 3 times per year.

#### 6.4 MASTER'S EXAM

The Field of Astronomy and Space Sciences accepts students only for the Ph. D. program however it awards Master's degrees in some cases.

If a student decides not to pursue the Ph. D. it is possible to earn a Master's degree without thesis by completing four semesters. The requirements are (1) pass the Q exam, (2) pass a final

exam for the Master's. No research is required. The final exam may either be a special Master's final exam or an A exam passed at the Master's level or better. Students who take the special exam or pass the A exam only at the Master's level do not continue in the program.

The format of the Master's final exam is determined by the special committee. It is generally an oral exam which includes a presentation by the student on a topic agreed to in advance by the committee. The student and committee discuss the requirements and expectations prior to scheduling the exam. The student should request a change of status to Master's candidacy.

## 7 FINANCIAL SUPPORT AND DUTIES

The primary types of financial support for students in the program are: (1) Teaching Assistantships (TA), (2) Graduate Research Assistantships (GRA) and (3) Fellowships, All provide a stipend sufficient to cover housing and living expenses in Ithaca, a tuition waiver, and medical insurance.

The field guarantees the support for the first six years (12 semesters) of enrollment in the program during the regular semesters (fall and spring). Many students also receive financial support during summer semesters. Support beyond the 12th semester may be possible but is subject to availability. Continued financial support presumes good academic standing and meeting performance expectations (duties); if not the support may be withdrawn.

The duties of the student depend upon the support.

### 7.1 TEACHING ASSISTANTSHIP

A Teaching Assistantship (TA) is an appointment in support of teaching a particular course. The instructor of the course (faculty or senior staff member) is the TA's supervisor. The Field does not have a teaching requirement but each graduate student is strongly encouraged to be a TA for at least one semester, even if other sources of financial support are available. The experience helps students to improve their own understanding, build confidence and presentation skills, and make a meaningful contribution to Cornell's educational mission.

Teaching assignments are made by consultation of the DGS, the Department of Astronomy Chair, the faculty supervising the relevant classes and each graduate student. Generally, TAs in the Field are assigned to the Dept. of Astronomy's introductory classes (Astro 1101/1103 and 1102/1104).

There are a limited number of positions. Positions are allocated to entering first year students and continuing second year students not otherwise supported by GRA. Advanced students (third year and beyond) may hold TA positions once the needs of the first and second year students have been accommodated.<sup>3</sup> There are numerous uncertainties so flexibility of

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<sup>3</sup>Each Fall the GFA and DGS canvas the Field members to quantify the TA support needed for advanced students and to estimate a suitable number of new acceptances. A TA position is allocated to a rising second year student if no GRA position can be identified. If/when GRA support materializes for such a student the Field attempts to release the student from the TA position without compromising the staffing needs of the department. Release requests are handled on a first come, first served basis. Also, sometimes anticipated grant support for GRAs is interrupted. The Field will attempt to accommodate advanced students as TAs. The advisor should contact the GRA and DGS as soon as the situation arises and reach out to other departments for TA positions if the

faculty and students is required. Staffing needs may require a student from another Field be assigned to TA in a Dept. of Astronomy class. Sometimes, a student in the Field will be offered a TA position in a closely related department.

All TAs take TA training prior to beginning their first appointment to help ensure success in the classroom. The responsibility for teaching science at all levels, elementary to advanced, is taken very seriously by all departments. TAs are expected to maintain the high standard of teaching that is the norm at Cornell.

Typical TA responsibilities include (1) handling discussion sections and/or labs, (2) grading homework assignments and exams, (3) attending lectures and staff meetings. Specific responsibilities and expectations vary by course, instructor and TA cohort. These will be clearly specified by the supervisor at the start of the appointment.

As an example, see the Table (created by Jack Madden) below that gives an enumeration of the breakdown of tasks for instructor, TA and head TA in a recent offering of the Astronomy introductory class. This is illustrative of the way in which responsibilities and expectations are determined before the class gets underway.

The Graduate School mandates that a TA work not more than 15 hours per week, averaged over the duration of the appointment, and not more than 20 hours in any individual week. If a student is unable to fulfill the assigned responsibilities within these limits, the issue should be discussed with the instructor, and steps should be taken to remedy the situation. (This may include advice on improving the TA's efficiency, as well as modification of duties.) In case of disagreements, the DGS should be contacted and will facilitate the discussion.

International students whose native language is not English must demonstrate English proficiency to be eligible to hold a TA appointment. The assessment is conducted by the International Teaching Assistant Program (ITAP), which also offers classes to help students improve their English proficiency if necessary, and eventually meet the standard required to teach. This is a university-wide requirement which cannot be waived or modified. If a student is not cleared to teach by ITAP, the field does its best to identify other sources of financial support, but cannot guarantee support.

## 7.2 GRADUATE RESEARCH ASSISTANTSHIP

A Graduate Research Assistantship (GRA) is an appointment with primary responsibility to conduct research related to the student's thesis. Typically, a Graduate Research Assistant (GRA) is supervised by the student's research advisor, although in some cases the supervisor may be different (e.g. if the student's project involves a close collaboration between multiple faculty). The responsibilities of a GRA position may vary widely depending on specific research area and project, but must focus on tasks advancing the student's thesis research. The supervisor should make the expectations clear at the start of each semester's appointment, including expected hours and other specifics as appropriate. In case of disagreements, the DGS should be contacted and will facilitate the discussion.

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accommodation by the Dept. of Astronomy proves problematic.

Frame	Duty	Professor	TA (includes lab TA unless otherwise noted)	HTA
Pre-semester	Creating the blackboard site	✓		
	Compiling the list of sections			✓ done before orientation meeting
	Organizing section assignments and office hour schedule			✓ during orientation meeting
	Dropping sections if necessary	✓ Primary		✓ provide recommendations
	Planning out homework due dates around the academic calander and exams	✓		
	Creating late HW policy	✓		
	Organizing Pre-semester meetings with all TAs/professors	✓		
	Outlining TA expectations before the start of semester	✓		
	Creating Syllabus and Lecture Schedule	✓		
During semester	Prepare 3 lectures a week	✓		
	Give 3 lectures a week	✓		
	Attend lectures		✓	✓
	Prepare 2 section lessons a week		✓ (not Lab TA)	✓
	Teach 2 sections a week		✓ (not Lab TA)	✓
	Run lab sessions		✓ only lab TA	
	Scheduling review sessions			✓
	Running review sessions		✓	
	Holding office hours		✓	
	Observing night planning			✓
	Running observing night		✓	
	Posting material to blackboard	✓ Lectures/course material/exams	✓ homeworks/solutions	✓ homeworks/ solutions
	Making/sending email announcements to the class	✓ course related	✓ office hour/section	✓ review session/observing night/general
	Coordinating 'extra time' students and making appropriate acomodations	✓ Primary		✓ assist with proctoring/seeduling
	Attend weekly meetings	✓	✓	✓
	Creating an agenda for weekly meetings	✓		✓
	Staying informed on all TA and course matters			✓
	Assisting guest lecturers			✓
	Implementing/writing course evaluations	✓ Primary	✓	✓
	Coordinating/scheduling a make-up final exam	✓ Primary		✓ assist with proctoring/seeduling
Arragning for lecture equipment needs	✓ Primary	✓		
Keeping TAs up to date on tasks			✓	
homework/Exam s	Write homeworks	✓		
	Proofread homeworks	✓	✓	✓
	Distribute homework		✓ (not Lab TA)	✓
	Collect homework		✓ (not Lab TA)	✓
	Grade homeworks		✓	✓
	Write homework solutions	✓		
	Record the homework grades		✓ for their section	✓ for their section
	Write exams	✓ Primary	✓ suggest questions	✓ suggest questions
	Proofread exams	✓	✓	✓
	Write exam solutions	✓		
	Print exams		✓	
	Proctor exams		✓	✓
	Manage scantrons			✓ (may not be necessary)
	Grade exams		✓	✓
	Record the exam grades		✓ for their section	✓ for their section
	Write final exams	✓	✓ suggest questions	✓ suggest questions
	Write final exam solutions	✓		
	Print/Proctor final exams		✓	✓
	Manage final scantrons			✓ (may not be necessary)
	Grade final exams		✓	✓
	Record the final exam grades		✓ for their section	✓ for their section
	Deliniate final grades	✓		
Handling grades when a TA is unable			✓	
Other Jobs	Manage intro astronomy archive	✓		✓
	Upload content to archive	✓		✓
	Mentoring, TA assesment in section	✓		

### 7.3 FELLOWSHIP

A fellowship does not require the student to teach for the University nor to perform specific duties for the University. The obligations of the student vary with the particular fellowship but generally the support is meant to further the student's education and advancement in various ways rather than benefit Cornell. Some fellowships set particular educational goals, such as taking classes and doing research on a particular topic.

Fellowships may be funded by Cornell (internal), or by outside sources such as US or foreign government agencies or private foundations (external).

Internal fellowships may require nomination by the Field. The DGS keeps track of available internal fellowships and selects or nominates prospective or current students as appropriate.

Students are strongly encouraged to apply for external fellowships. The field endeavors to support such applications in every way possible; in particular, faculty are highly encouraged to help students prepare research plans/proposals required by many fellowships. Students are also encouraged to make use of the resources provided by the Graduate School to find information about available fellowships and to help with applications. Students who are awarded an external fellowship should notify the GFA immediately, even if they are not planning to use the fellowship right away. It is the fellowship recipient's responsibility to understand and maintain eligibility conditions for the duration of the fellowship. Partial fellowships may be eligible for Graduate School supplement; students should contact the GFA with questions concerning eligibility rules.

## 8 GRADUATE STUDENTS FROM ALLIED FIELDS

Students from other Fields (Physics, Geology, Earth and Atmospheric Sciences, etc.) often work with advisors in Astronomy and Space Sciences. Students should ask their advisors to request office space from the most appropriate department or unit. Most Astronomy and Space Science field members are situated in the Dept. of Astronomy in the Space Sciences Building.

Where appropriate students from allied fields are encouraged to add a minor committee member from Astronomy and Space Sciences to their committee. The Field of Astronomy and Space Sciences currently imposes no general requirements and the minor committee member determines the specific requirements the student should fulfill for the minor.

Students from other Fields may also consider transferring into Astronomy and Space Sciences. In general, the DGS should be consulted because such a move requires planning and has impacts on funding and completion timeline. The field expects that the student has identified a new advisor in the field who supports the transfer. Grades and letters of recommendation are considered. The Field coordinates its decision with the regular admissions process. New transfer students take the Q, A and B exams.

## 9 ASTRONOMY GRADUATE NETWORK

The Astronomy Graduate Network (AGN; <https://astro.cornell.edu/agn>) is not a formal part of the Field's Ph. D. program. Because it plays an important, integral role for graduate student life the Handbook summarizes the AGN.

The AGN serves to represent and promote the interests and visions of graduate students in the Astronomy Department and Space Sciences Building. AGN also aims to foster a sense of community and to increase awareness and enthusiasm for Astronomy at Cornell and within the general public.

To these ends, it holds a variety of events each year, including a weekly journal club and Grad Student and Postdoc Seminar (often followed by an informal get-together at the Big Red Barn). AGN also hosts frequent social events, including game nights, ice cream socials, informal dinners with Astronomy faculty, camping trips, and more. The elected AGN officers (President, Vice President, Treasurer, Secretary, Outreach Coordinator, and Field Representative) work with the graduate student body to organize these events and administrate AGN's activities as an official Cornell student organization.

**Outreach:** AGN organizes a number of outreach activities throughout the year, including Museum in the Dark, 4-H Career Explorations, Expanding Your Horizons (EYH), and Science Day at the Big Red Barn. Graduate students are encouraged to participate in these activities, both as organizers and volunteers in the activities themselves. In addition to the activities mentioned above, which are oriented towards preschool through high school ages, graduate students frequently have the opportunity to give public evening talks at local libraries. Astronomy grad students can also engage in outreach through the Space and Planetary Imaging Facility (SPIF) located in the Space Sciences Building. Opportunities to get involved in outreach programs are regularly advertised by the AGN Outreach Coordinator.

AGN also maintains the Ask an Astronomer website (<https://curious.astro.cornell.edu>), where graduate students answer questions from the public about astronomy and astrophysics. Each semester AGN organizes sessions where students respond to questions on the website together.

**Peer Mentoring Network:** The AGN Peer Mentoring Network connects incoming graduate students with upper level graduate student mentors. Mentors meet regularly with incoming students starting in the summer prior to their first year and provide them with resources and support during their transition into the program.

## 10 ASSISTANCE

Names here will change yearly.

### 10.1 IMMEDIATE SUPPORT FOR FIELD RELATED ISSUES

People ready to respond:

- Director of Graduate Studies (DGS David Chernoff)

- Graduate Field Assistant (GFA Monica Carpenter)
- First Year Committee (Nick Battaglia, Jim Cordes, Jamie Lloyd for Fall 2020 incoming students) and/or Permanent Special Committee
- AGN (Pres. Stella Ocker)
- Grads: all students affiliated in some way with the Field included in the mailing list [grad@astro.cornell.edu](mailto:grad@astro.cornell.edu)

## 10.2 DEPT. OF ASTRONOMY AND CORNELL CENTER FOR ASTROPHYSICS AND PLANETARY SCIENCE (CCAPS)

Many but not all field members reside in the Dept. of Astronomy and/or CCAPS. Here is a brief listing of positions (individuals) involved in running the Department and Center:

- Department Chair (Jonathan Lunine)
- CCAPS Directory (Alexander Hayes)
- Assoc. Director, Department Manager (Mary R. Mulvanerton, Esq.)
- Finance and Human Resource Manager (Lynda Sovocool)
- Front Office and Financial Coordinator (Jessica Jones)
- Facilities Manager (David Pawelczyk)
- Network/System Administrator (Bez Thomas)
- Desktop Support Manager (Jason Jennings)

They are ready to provide help in their respective areas of expertise.

## 10.3 CLIMATE AND DIVERSITY COMMITTEE

The Cornell astronomy climate and diversity committee has been established to set up and maintain a system for promoting an environment in the Department which facilitates collaboration, inclusion, mentorship and respect. The committee is responsible for organizing educational opportunities, and examining our reporting, admissions, and workplace processes.

<https://astro.cornell.edu/climate-and-diversity>

It provides guidance to accessing free and confidential Cornell resources.

It provides an anonymous contact form to bring concerns to the attention of the committee or to make suggestions on improving the climate of the Dept. of Astronomy and the Center.

Jonathan Lunine (Department Chair), Mary Mulvanerton (Associate Director), or David Chernoff (Director of Graduate Studies) will be happy to assist with department related issues.

## 10.4 GRADUATE SCHOOL

The Graduate school has a wide variety of resources:

- Grad school news/emails:

[gradschoolnews@cornell.edu](mailto:gradschoolnews@cornell.edu)

Bulk emails – but don't delete on sight, they contain many announcements relevant to your life at Cornell including COVID-19 updates, general news, external grants, career and graduate development activities, etc.

- Grad school website:

<https://gradschool.cornell.edu>

Info on policies, careers advice, academic calendar, scholarship, fellowship and grant aid, leaves, family and life balance. You will find all the forms you might need to fill out between here and graduation at <https://gradschool.cornell.edu/forms>

- Financial Support:

<https://gradschool.cornell.edu/financial-support>

For unresolved questions about assistantships, fellowships, loans, stipends or tax information please contact the Grad School Office in Caldwell Hall (607-255-5820) as soon as possible. For example, if you are taking out any student loans, you should get a loans file set up soon so that the funds will be available for you by the Fall semester.

## 10.5 UNIVERSITY WIDE

The University provides many resources:

- Health Care:

<https://health.cornell.edu>

Care, services, a huge number of resources, FAQs and initiatives. There are telehealth and in person services. 24/7 consultation.

- Center for Teaching Innovation:

<https://teaching.cornell.edu>

Excellent courses, teaching support, advise and training opportunities for all members of the Cornell community with many tailored specifically for graduate students (GET SET program, International TA program, Teaching Portfolio Program, CTI Fellowship)

- Cornell International Services for Global Learning:

<https://international.globallearning.cornell.edu>

Applying for student status, entering the US, travel to campus, check-in, etc. This resource will be of special use for those navigating life at Cornell as a foreign student.

- Library:  
<https://www.library.cornell.edu>
- Assistance for any member of the Cornell community who has been the victim of a crime, bias, or other traumatic incident:  
<https://health.cornell.edu/services/victim-advocacy>

## 11 GUIDE TO HELP, INCLUDING URGENT SITUATIONS

A compendium on getting help in a wide range of situations is

<https://caringcommunity.cornell.edu/get-help>

The topics encompass many possibilities, a subset is reproduced here:

- Crises: emergency, urgent medical or mental health
- General: Blue Light Services, shuttles, buses, confidential 24-hour helpline for health and human services, victim advocate, University ombudsman, wellbeing programs
- Emotional: professional counseling and support, peer counseling, mental and emotional health, religious work, LGBT resources, dealing with people in distress, domestic/intimate partner/dating violence, sexual harassment response and education, stress
- Physical: Cornell Health Center, fitness, outdoor education, disability information, sexual health care, domestic/intimate partner/dating violence, health plans, health benefits, leaves
- Social: student organizations, recreational services, religious work, student life, global learning, volunteer opportunities, identity resources
- Financial: financial aid
- Intellectual: academic advising, learning strategies, student disability services, global learning, career services
- Family Life: students with families

Note the compendium references specific webpages for each topic and is updated regularly.

## 12 DEFINITIONS OF IMPORTANT TERMS

### *The Graduate School:*

While undergraduate students at Cornell may be enrolled in one of the several Colleges, all graduate students, regardless of the field of study, are enrolled in the Graduate School. The Graduate School issues policies and requirements applicable to graduate students in all fields. It handles administrative aspects such as registration, record-keeping, leaves of absence, and degree conferral. In addition, the Graduate School provides a variety of resources in support of graduate students' professional development and overall well-being. More information is available at <https://gradschool.cornell.edu>

### *Graduate Fields:*

Graduate fields are voluntary groupings of members of the graduate faculty who have academic interests in common and who wish to exercise shared responsibility for an area of inquiry and for the admission, education, and, as appropriate, financial support of graduate students. Fields are independent of traditional college or department units, so they may draw together faculty members from several colleges, departments, and related disciplines in accordance with scholarly interests. Astronomy and Space Sciences is one of 96 fields at Cornell.

### *Director of Graduate Studies (DGS):*

The DGS represents a field in matters such as: (1) promoting the quality of graduate education within the field, including regular assessment of learning outcomes, (2) promoting the well-being of graduate students within the field. coordinating the establishment of academic priorities and allocation of resources for graduate education within the field, (3) overseeing the field's admissions process, and (4) serving as liaison between the field and the Graduate School.

The DGS should: (1) Communicate regularly with graduate students in the field (e.g., email, regular office hours, occasional town hall meetings). (2) Be regularly accessible to graduate students in the field. (3) Facilitate conversations between graduate faculty and students as needed. (4) Convene the graduate faculty as needed to consider the quality of graduate education in the field, policy matters, and graduate student progress and outcomes.

### *Graduate Field Assistant (GFA):*

The GFA assists students with graduate program milestone requirements, scheduling exams, Graduate School forms, questions about committee changes, applying for a leave of absence or in absentia, fellowships awards, obtaining the DGS signature and making an appointment with the DGS.

### *Special Committee:*

The special committee, under the leadership of the committee chair, has primary responsibility for developing the student's independence in scholarship. Special committees and students meet at least once per semester.

There are no regulations governing the number of courses, grades, or specific content of instruction to which special committees must subscribe. Astronomy and Space Sciences requirements are stated in terms of range and thoroughness of knowledge rather than in the form of a list of prescribed courses. Special committees may impose any requirements over and above the requirements of the Graduate School that they deem educationally sound.

Two types of special committees:

*The First Year Committee* is assigned to the matriculating student and meant to be replaced by the student after the Q exam. A student selects the members of the *permanent special committee*, with their consent, from the current graduate faculty. Any member of the graduate faculty may serve on a special committee. The DGS must endorse the proposed special committee membership.

A doctoral student must have at least three members of the graduate faculty on the special committee—one in the major subject (the chair) and two in the minor subjects. The Field of Astronomy and Space Sciences allows the minor subjects to be from any relevant field. The Field requires a field-appointed member selected by the DGS so each committee has 4 members.

*Chair:*

The representative of the major subject is the special committee chair. The chair supervises the thesis or dissertation. Together with the appropriate administrative unit (e.g. Dept. of Astronomy) the chair also assumes responsibility for providing facilities necessary for the student to pursue the student's thesis or dissertation research.

*Co-chair:*

Co-chairs are possible. A co-chair has the same rights, responsibilities, and obligations as a single special committee chair; both co-chairs must fulfill all chair requirements. A committee with two co-chairs has one additional minor member and the Field-appointed member.

*A-exam:*

A student is admitted to doctoral candidacy after passing a comprehensive examination administered by the student's special committee. This examination is determined by the special committee. The passing of this examination certifies that the student is eligible to present a dissertation to the graduate faculty.

*B-exam:*

A doctoral candidate takes the Final Examination upon completion of all requirements for the degree (and satisfying minimum registration requirements). A minimum of two semesters of registration must be completed between passing the A exam and scheduling the B exam. This oral exam covers the general subject of the dissertation.

*Faculty duties of the First Year Committee (specific to Astronomy and Space Sciences):*

The first year committee is one of the most important committees because it guides graduate students towards the beginning of a successful research experience. Faculty engage in 3 main tasks. Let X stand for a particular calendar year. The tasks are:

1. Reading applications (end-of-Fall X-1); selecting new students (beginning-of-Spring X),
2. Advising (Fall X to end-of-Fall semester X+1 [or beyond as needed]),
3. Q exam (Summer X+1).

In summary, the committee picks the new students, advises them the first year, tests them after the first summer and stands down as soon as each student has selected a thesis advisor and permanent special committee. The tasks span up to 2 calendar years.

All 3 tasks are time-critical. Applications need to be read and ranked early in year X. Students need course advice near the beginning of each semester. The diagnostic Q-exam must follow

the summer's research experience but precede the beginning of classes. Faculty serving on the First Year Committee should look carefully at these windows of time: reading applications (typically 1 week before classes begin in the spring), advising (typically the week classes begin in fall and in spring), Q (the week before classes begin in fall).