

# NMSU

## Department of Astronomy

### Department Handbook

#### 2020-2021

## 1 INTRODUCTION

Welcome to the NMSU Department of Astronomy. We strive to provide a vigorous, exciting program of research and education in Astronomy and Astrophysics, covering a broad range of interests, from planetary science and extra-solar planets, to cosmology. With the ARC 3.5-m and NMSU 1-m telescopes at the Apache Point Observatory, as well as the Sloan 2.5 meter telescope at APO and our 24" at Tortugas Mountain, we offer exciting opportunities for observational projects. These telescopes combined with the Sunspot Solar Observatory at Sacramento Peak, the National Radio Astronomy Observatory near Socorro, NM, the Los Alamos and Sandia National Laboratories, Kirtland Air Force Base, all of the national facilities, as well as the in-house NASA Planetary Data System Atmospheres data archive Node, offer excellent opportunities for research on the MS and Ph.D. levels.

This guide is intended to help you through the procedures required by NMSU to achieve an advanced degree in Astronomy. You should read it carefully and then feel free to ask your faculty advisor any questions that arise. This document is constantly evolving, so any comments that you have to improve it would be appreciated. The policies and procedures outlined in this guide will be effective for the 2020-2021 entering class. More senior students may choose to follow these guidelines or those given to them upon entrance into the program.

Please note that it is impossible for any written guide to anticipate all questions that students may have about the program, and that the program itself is an evolving entity. If there are any doubts or questions about the program or material in this handbook, **students should consult with the faculty. We strongly value good communication between students and faculty. Points of contact with the faculty include your advisor, the Department head, and the First Year Advisor. We encourage students to come directly to faculty to quickly and accurately resolve issues and answer questions.**

## 2 COMPONENTS OF THE ACADEMIC PROGRAM

There are many different facets of participating in our graduate program, and one issue you should think about is time management, i.e., how much time you spend overall on the program and how much time you choose to spend on the different aspects. While the faculty and staff are here to help and advise you, ultimately what you get out of the program and your future projects are determined by your efforts and choices.

Students often want to know how to prioritize the different aspects of the program. This is a challenging question, and the choices may differ for different students and at different times in the program. It is important to recognize that individual students need to decide for themselves, at some level, how they choose to prioritize their time. Again, students are encouraged to discuss with the faculty their thoughts about prioritization, and to get feedback from the faculty.

### 2.1 Research

Most students enroll with the goal of becoming an academic researcher as a career, and we have developed our program primarily with this goal in mind. However, it is becoming increasingly challenging to obtain long-term employment in an academic position, so you should be aware that achieving this goal is likely to require significant time and effort.

While research is often the primary goal of students, it is often the hardest to allocate time towards, especially in the first several years of the program, because of competing demands of classes, teaching, and outreach. If research is a high priority for you, we urge you to set aside time specifically for it.

Note that research involves not only studying a topic to achieve new knowledge, but also to disseminate this knowledge. The primary dissemination tool in academics is via scientific publications, and in most cases, the primary judgement of people (e.g., in job searches) is their publication record. As you proceed with research, we strongly recommend that you work on writing up your results as you are developing them, so that the process of writing becomes integral to the research process.

Some key ways to get up to speed on active research areas are to

- read papers: you should be aware of the main journals and, in particular, the astronomy preprint archive, astro-ph. Get in the habit of looking at this regularly, and downloading and reading papers. Keep track of the papers that you have read: if, after some time, you find the list is short, recognize that you need to put aside more time for this
- talk about research: you can talk with other students, with faculty, or with visitors. Discussions are a way to develop your ideas and get new ones. If you don't like talking about research, you probably won't end up doing it
- go to meetings where you can hear about and present research results. While there are several large general meetings in astronomy (the American Astronomical Society twice annual meetings plus the Division of Planetary Sciences annual meeting), these general meetings often do not provide the best opportunity to recognize the level of research that is being done (often by graduate students) by people who will succeed in the field. Look for topical meetings on subjects that you are working in, and try to find ways to go to these.

Plan to talk with your advisor (or any faculty member) regularly about research and about their opinions on what it will take for you to succeed. Discussions about research should take place frequently; it usually does not work to save up a lot of issues to discuss. A guideline of talking to your advisor *once per week* is probably reasonable!

## 2.2 Classes

Classes are a very significant component of the program during the first two years. While the academic requirements for the program are outlined in detail in a subsequent section, a few key points may be of interest:

- astronomy, like other fields, is constantly advancing and, in many cases, becoming increasingly specialized. While our classes aim to provide you the fundamentals, as well as making you aware of the latest advances, it is impossible to cover “everything”, even everything that you will probably need to know if you go on in the field. Classes provide an introduction and a framework for you to understand new material, but you will almost certainly need to learn, and continue to learn, through your own initiative, outside of classes. Do not be fooled into thinking that, if you know everything that is taught in class (but no more), that you will be sufficiently prepared! We urge you to think about what you want to know, and then go try to learn it, through asking questions, reading books, or reading research articles.
- Grades in graduate school are generally nowhere near as important as they are for undergraduates. If you want to go on in the field, people will most likely scrutinize your research record **far** more than your grades. Of course, understanding the material is critical, and related to the grade you get, but the understanding and ability to apply it is much more important than the grade itself.

## 2.3 Teaching

Teaching is an important component of the program, as many career paths after the program may involve it. Obviously, if your primary goal is an academic position, teaching will be involved. Universities are increasingly interested in the quality and innovations in teaching in addition to research accomplishments, so this is not to be taken lightly. Furthermore, many of our graduates end up in predominantly teaching positions, where it is clear that teaching experience is critical.

Another important role of teaching is that it generally provides financial support for many of our students.

Most of our teaching assistants are for our introductory undergraduate classes, ASTR 105 (The Planets) and ASTR 110 (Introduction to Astronomy). If you are a TA for one of these, your primary duty will be to teach the lab sections of the class and grade the lab reports. It is critical that you are familiar with the labs beforehand for

them to go smoothly! There are several resources available to help you with this: generally, the TAs schedule weekly meetings to go over upcoming labs, and previous TAs have put together notes and teaching materials for most of the labs. In addition to labs, you will also likely be called upon to help grade exams, and possibly homeworks, from the main class section.

We also teach several 300 level undergraduate classes, which generally have more writing assignments. TAs in these classes generally spend more of their time grading papers.

There has been a lot of recognition recently that traditional modes of teaching may not always be especially effective, and that we often call upon people to teach without giving them any instruction in how to do so! We urge you to think about your teaching, and discuss how you do it with faculty and other students. Many people have lots of opinions about good ways to do things.

A key component of effective teaching is getting students to be excited and enthusiastic about learning. Much of student behavior can be generated by teacher behavior. If you are excited and interested by what you are talking about, it becomes more likely that the students will be. While we can't guarantee that this will be true for all students, the converse is almost always true: if you aren't excited and interested, the students almost certainly won't be either! We recognize that it's not always easy to project a positive attitude; a little bit of acting is sometimes called for!

Another aspect of a TA position may be that you will be called on to help out at the campus observatory. Generally, we require all students in the ASTR110 classes to go to the campus observatory twice in a semester; this means a total of roughly 500 visits to the observatory in a semester. We usually have the campus observatory open two nights a week, staffed by different TAs on different nights. It is important that you are comfortable with knowing what is in the sky and knowing how to operate the telescopes before you are involved in one of these sessions! Note that campus observatory knowledge is also required when you will be helping out with one of the department's monthly open houses. Our lab/observatory manager usually holds a campus observatory training session at the beginning of each year.

### 2.3.1 Teaching expectations

Being a teaching assistant does entail some significant responsibility. Obviously, you need to show up for your teaching assignments. On top of this, however, timely grading of labs and other materials is of critical importance to the students who are taking the class; they deserve timely response to their work. It is also in your best interest to keep up with grading: putting it off will not make it go away!

If you find that you are having a hard time keeping up with grading responsibilities, discuss the situation with the professor of the class *as soon as possible*. It may be that you are taking more time to grade than might be required, and the professor (or other TAs) might be able to provide some tips and guidelines for how much time you should take.

**If you cannot meet your responsibilities as a TA, there is the possibility that we will not be able to hire you as a TA in future semesters, which in turn could have significant implications for financial support.**

## 2.4 Public Outreach

Most of the money which support the department (and astronomy in general) are derived from state and federal tax dollars, and thus from residents of the state and country. In return for this support, it is our responsibility to "give back" our knowledge to the public. Fortunately, in astronomy, many people are genuinely interested in what we do, and talking with them about it can be a lot of fun!

The department has a good reputation in the local community for outreach efforts, and we wish to continue this. Our graduate students provide critical role in these outreach activities, which include presentations to schools in Las Cruces and the surrounding southern New Mexico communities, local civic groups, local astronomical interest groups, etc. Some of the outreach events are nighttime events that involve looking at the sky, while others are daytime events.

We strongly encourage students and faculty members to participate in outreach efforts and have a expectation that graduate students will do a minimum of two events each year. Usually, local groups approach the department with a request for someone to do an event with them. These requests are channeled to the Astronomy Graduate Student Organization (AGSO) officers, who are responsible for finding volunteers to do the event, and for keeping

records of what events are provided, and who volunteers for them. Note that there are some perks for participating in these events: they count as public service events for the NMSU Graduate Student Organization, and, if an individual has sufficient hours of public service, you can apply to the NMSU GSO for funding assistance, e.g. with travel to conferences, etc. In addition, the Department makes some financial outreach awards to students who have done more than their share of outreach events.

An additional outreach activity which each student and faculty member will participate in each year is our monthly Observatory Open House. These events are held on the Friday evening nearest in time to first-quarter moon each month of the academic year. These events, well known and well attended, offer the community the opportunity to view the skies through the telescopes here on campus at the Tombaugh observatory. A schedule of participation will be distributed at the start of the Fall semester. At these events, graduate students are generally expected to run the telescopes, so it is important to be well trained on operating them *before the open house*.

While you might feel pressed for time preparing for these outreach activities (we do realize that you are very busy with other activities too), it is important to convey your enthusiasm for the astronomical work you are involved in. The public in general finds what we do very exciting and interesting (and fun!), and above all else, your demonstration of such.

## 2.5 Suggested Milestones in the Graduate PhD Program

As you think about the graduate program, you might consider some typical timelines toward completion of a Ph.D. Later sections in this guide describe some of these things in more detail.

Year	Category	Activities
1	Classes	Usually 3 standard (3 x 3-credit) classes + seminar (1-credit) each semester
	Other learning	based on material in classes, with other students, and your interests, read supplementary material
	Teaching	Learn and teach undergraduate labs recognize different teaching styles and develop yours
	Research	identify a topic you're interested in, perhaps with your initial advisor, work on during year as time allows, but significantly in summer
	Exams	take cume exams monthly, starting spring semester
	Outreach	several events
	Other	<b>Establish NM residency</b>
2	Classes	One semester lower standard class load (2 x 3 credit) plus a research course (ASTR 598, 3 credits )
	Teaching	continue to develop teaching style and skills
	Research	ramp up time spent on research. Think about advisor, thesis and funding possibilities
	Exams	continue monthly cumes; take "qualifying" exam (just a committee meeting!) to certify program advancement (slight pay raise!)
Outreach	several events	
3	Classes	take remaining classes per your interest; research credits (ASTR 598/600, ASTR599 for Masters thesis)
	Research	Identify thesis topic, finalize committee, prepare thesis proposal, make external contacts (perhaps including them on committee, consider funding possibilities. Consider attendance at topical conferences.
	Teaching	as necessary
	Exams	finish remaining cumes if necessary; take oral classwork exam (fall); thesis proposal (spring)
	Outreach	several events
Future prep	start thinking more about job interests	
4	Research	Work on thesis! Remember to be writing as you work!
	Future prep	Consider job interests/possibilities; make external contacts; recognize job application timescale and associated timescale for supporting materials (i.e. published papers!); consider presentation at conferences
	Classes	Research credits (ASTR 700)
	Teaching	As necessary
Outreach	several events	
5	Research	Finish thesis!
	Future prep	Job applications!
	Classes	Research credits (ASTR 700)
	Teaching	As necessary
	Exams	Dissertation defense
Outreach	several events	

Please note that the above are only rough guidelines. Each student will take a somewhat unique path – some will finish sooner and some will complete the Ph.D. later.

## 2.6 Job awareness and expectations

Students should be aware of the challenges involved with obtaining long-term employment in the field of astronomy; there are far more graduate students than there are faculty positions. That being said, there are a number of related

jobs, and the skills that you obtain in graduate school can be useful even in other fields. You may wish to consider, and discuss with the faculty, how you might best be able to develop and document skills that may be useful when seeking employment, either within astronomy or outside the field.

If you plan to continue in the field, note that it may be important for you to make connections with professionals outside of the Department. The more other people know about you, the greater the possibility of job offers will likely be. External contacts can be an important source of recommendation letters for job positions, but they must know enough about you and your work to be able to write strong letters.

Note that the American Astronomical Society compiles information related to career resources at <https://aas.org/jobs/career-resources>

## 2.7 Time expectations

If you ask most practicing astronomers about how much time they spent doing astronomy during graduate school, you will probably hear some very large (possibly unrealistic?) numbers. If you ask most astronomers how much time they spend on their job now, most will probably give a number larger than 40 hours per week.

Many people in the field of astronomy (including most of us) in general are trying hard to recognize the importance of a balance between work and other life activities, and we do not think spending more than 40 hours per week should be a *requirement*. However, you should be aware that most of the people in the field say that they spend more than this. The key to being successful, especially if working in the framework of a 40 hour work week, is almost certainly being extremely careful about making your work hours productive! Certainly, we do feel that being successful in graduate school requires a full-time committment, so you should plan and expect to dedicate a productive 40 hours a week at least.

Time management is an essential skill, and even more essential if you want to succeed without having to put in an excessive amount of time. Think carefully about how much time you want and need to put into your various different activities. Again, your advisor is a good resource for assistance with time management.

In summary, the tasks that students must learn to balance include:

- Coursework: homework, exam preparation;
- Teaching: Leading labs, resolving student concerns, and grading;
- Research: reading, first-author work, nth-author work, conferences, attending colloquia and other discussion groups, proposals (for grants, telescope time, or postdocs)
- Outreach

This is clearly a lot of balls to juggle. All of these tasks are important, but not equally so. For example, grants and meetings are usually more important than homework, and grading is usually more important than outreach. A key skill for graduate students to develop involves learning to balance these tasks without neglecting any of them. For example, it is far better (and more difficult) to cut research back to 15-30 minutes a day during exam season than to eliminate it entirely. More than one faculty member actually uses an electronic app such as TimeEdition or Toggl to track how they divide their time; you may find this data useful when discussing progress with your supervisor. Here is a sample weekly time allocations for students who are TAing:

- Teaching: < 20 hours; ideally < 14 hours
- Coursework (including attendance at lectures and homework): > 21 hours
- First-author Research: 2.5 hours
- Group meetings / Colloquia: 2.5 hours

Of course, you should expect some, possibly significant, variations in individual weeks. But if you are spending zero hours per week on research or 25 hours per week on teaching, averaged over a month, please ask your supervisor for suggestions soon.

### 3 PERSONNEL

For the 2020-2021 academic year, there are eleven tenure-track faculty, three emeritus professors, several research associates and postdoctoral assistants, two professional office staff, nearly thirty Apache Point Observatory staff, and several dozen graduate students in the Astronomy Department. In addition, there are many adjunct faculty affiliated with the department from various other institutions, and we typically have numerous visitors throughout the year. Please feel free to talk with any and all of them on a regular basis. We are here to help you through your course work and to advise you on your research. Below, the names and research areas of our faculty are listed. If you have an interest in one of the research areas of these individuals, seek him/her out and begin discussions about her/his field and possible research problems. We encourage you to start working with the faculty as soon as possible on problems of interest in research.

#### 3.1 Faculty

Tenured or tenure-track

Joe Burchett	Assistant Prof.	Gas around galaxies, galaxies
Nancy Chanover	Prof.	Planetary Atmospheres, Instruments, PI of PDS Atmospheres Node, APO 3 Director
Chris Churchill	Prof.	Quasar Absorption Lines, Intergalactic Medium
Kristian Finlator	Assistant Prof.	high redshift galaxy evolution, hydrodynamic simulations
Jon Holtzman	Prof./Dept. Head	Stellar Population in Galaxies; Star Formation Histories in Galaxies; Ins mentation.
Jason Jackiewicz	Prof.	Helioseismology, Solar Physics, Space Weather, Condensed matter physics
Wladimir Lyra	Assistant Prof.	planet formation, MHD, computational astrophysics
James McAteer	Associate Prof.	Solar physics, space weather
Eric Nielsen	Assistant Prof.	Extrasolar planets and direct planet detection, stars
Moire Prescott	Assistant Prof.	high redshift galaxy formation, Lyman alpha structures
Juie Shetye	Assitant Prof.	Solar physics, chromosphere
Other		
Kurt Anderson	Emeritus Prof	Galaxy Morphology, Active Galactic Nuclei, Stellar Evolution.
Jim Murphy	Associate Dean	Atmospheric Science, Martian Atmosphere, Mars Exploration Missions
Reta Beebe		Planetary atmospheres; HST, Voyager, and Galileo spacebased observations
Rene Walterbos	Emeritus Prof.	The Interstellar Medium of External Galaxies, Galaxy Evolution, Massive S lar Populations, Galactic Structure

#### 3.2 Research Associates

Lyle Huber	Planetary Data System Atmospheres Node
Joni Johnson	PDS Atmospheres Node
Lynn Neakrase	PDS Atmospheres Node
Irma Trejo	PDS Atmospheres Node

#### 3.3 Postdoctoral Assistants

Tina Gueth	PDS Atmospheres Node
Ondrej Prochazka	solar group
Shuo Wang	solar group

#### 3.4 Department Staff

Ofelia Acosta	Administrative Assistant
Lydia Medrano	Accountant
Zachary Edwards	Lab/Observatory Manager

### 3.5 Apache Point Observatory

Dmitry Bizyaev	2.5m observer
Tina Blay	buyer
Christian Carter	2.5m observer
Frances Cope	fiber optic technician
Jack Dembicky	3.5m observing specialist
John Downey	chief telescope technician, 2.5m
James Eriksen	Director of Operations
Bill Fayter	Machinist
Tracey Fernandez	IT
Dylan Gatlin	2.5m observer
Katie Grabowski	2.5m observer
Candace Gray	3.5m observing specialist
Ben Harris	site supervisor
Bill Ketzeback	chief telescope engineer, 3.5m
Karen Kinemuchi	2.5m observer
Ed Leon	electronics engineer
Viktor Malanushenko	2.5m observer
Russet McMillan	lead support astronomer, 3.5m
Fred Mrozek	chief telescope technician, 2.5m
Tracy Naugle	lab tech
Dan Oravetz	2.5m observer
Audrey Oravetz	2.5m observer
Kaike Pan	2.5m head observer
James Parker	electronics
Ted Rudyk	3.5m observer
Muwen Shi	Fiber Optics technician
Shane Thomas	IT
Diana Torres	program manager
Ryan Wagner	telescope technician, 2.5m

### 3.6 Sunspot Solar Observatory

Dean Nabhan	Engineering support
Ben Novisoff	observer
Joey Fish	IT
Liz Jones	Visitors center
Heidi Sanchez	Visitors center

## 4 FACILITIES

### 4.1 The Astronomy Building

Your primary base of operation will be the Astronomy Building. All students are assigned an office, and given keys to their office and the outside doors by the Department Administrative Secretary, Ofelia Acosta. Please get to know Ofelia and respect her rules for the building.

The mailing address for regular mail is:

Department of Astronomy  
Box 30001  
MSC 4500  
New Mexico State University  
Las Cruces NM 88003

The shipping address is:

Department of Astronomy



1320 Frenger Mall  
New Mexico State University  
Las Cruces NM 88003

In addition to the offices and the departmental office in Room 100, there are several other rooms in the Astronomy Building with which you should become acquainted. The copying machine is located in Room 116 (across the hall from the Department office).

Across from the mailboxes is the coffee and snacks room. Please keep it clean!

The primary computer facilities for the department are located in Rooms 118 and 217 (see below). The Astronomy Conference Room is in Room 119; it is the site of graduate Astronomy classes and noontime seminars.

Building security is an issue that we should all be aware of. After 5:00 pm and on the weekends, the Astronomy Building is to remain locked. In these off hours, please close and lock the library and computer room doors before leaving the building. Your care and attention to building security can help to prevent any loss of personal or department property.

The Astronomy department will be your home for the next few years. Please treat it with care and respect. Over the past years, the building has been completely remodeled, and we wish to keep it looking good for years to come.

There are several other buildings in proximity to Astronomy with which you should also become familiar. The science library in Branson Hall just to the north of the Astronomy Building. You should acquaint yourself with the generally good Astronomy book and periodical collections there on the third floor. The Frenger food court is just east of the building, and the main Zuhl library is just beyond that. The Corbett Student Union has some other food options and offers general student area with several services.

Our regular undergraduate classroom and colloquium room is Biology Annex 102 (BX102). The Biology Annex is located immediately opposite the Astronomy building, to the south. Most of the ASTR 105G and 110G lab equipment is located in the auxiliary room in the back of BX 102. If you are employed as a TA, you should get a key to BX102 from Ofelia Acosta. BX102 has a projector that can be used to display images from a computer or a video player. There is a computer in the room, and also a video cable for a laptop. The computer is connected to the network, and an Ethernet cable is available for a laptop to do the same. Familiarize yourself with usage of the equipment before planning to run a lab or make a presentation! A key to the projection cabinet is usually kept inside the auxiliary storage room in BX102, hanging on the light switch.

#### **4.1.1 Department Library/Visitors office**

The Astronomy Department maintains a small library in Room 207, which includes a copy of all previous dissertations of Department graduates. This room also doubles as a visitors office and study space, so please respect the multiple uses of the space.

Some recent Astronomical journals plus recent preprints of papers from institutions around the world can be found in the reading room. Older issues of most of the science journals can be found in the Branson Hall Library. Finally, star and galaxy atlases, the Palomar Sky Survey, and the ESO Southern Hemisphere Survey can also be found in the library. CD ROMs containing the digitized POSS I survey, the digitized southern sky survey, ROSAT and Einstein observatories images, etc. are located in the Computer Machine Room.

Books and older journals can be checked out of the Department's library using the check-out sheet. However, new journals are not to be removed from the library except for copying. This should be done quickly and the journal should be returned promptly.

Requests for additional books for the main library should be made to Anatoly Klypin.

#### **4.1.2 NASA Planetary Data System (PDS) Planetary Atmospheres Node**

The Astronomy Department is home to NASA's Atmospheres Node of the Planetary Data System, which means we host data from space missions involving planetary atmospheres and provide access to it to the general community.

The PDS node has a big office in the middle of the building upstairs (Room ??) and has four permanent staff members and a number of student staff members.

## 4.2 Observatories

### 4.2.1 Apache Point Observatory

NMSU operates the Apache Point Observatory, which is located in the Sacramento Mountains east of Las Cruces, about a two hour drive away. APO is home to four telescope:

- the ARC 3.5m telescope
- the Sloan Digital Sky Survey (SDSS) 2.5m telescope
- the NMSU 1m telescope
- the ARCSAT 0.5m telescope

You should definitely consider these facilities for possible research projects; they provide resources that are not available in all graduate programs! Take some time to learn about their capabilities via information on the web and/or by talking with faculty and other students.

#### **ARC 3.5m Telescope**

The 3.5m is scheduled on a quarterly basis: Jan-Mar (Q1), Apr-June (Q2), July-Sep (Q3), and Oct-Dec (Q4). NMSU gets 15.625% of the time, in proportion to its contribution to the operations costs, split between bright and dark time. The time is allocated internally in the Department, but is scheduled by the ARC 3.5m management team. Since advance time is needed for both the allocation and the scheduling, NMSU proposals are generally due early-mid month of November (for Q1), February (for Q2), May (for Q3), and August (for Q4): you should receive email soliciting proposals a few weeks before these deadlines.

If you have any interest in the 3.5m telescope and certainly if you ever plan to propose for time, you should subscribe to the apo35m-general email list (it does not generate a lot of traffic!). This is how the telescope schedules are distributed, and, if you are successful in proposing for time, how you will find out when time has been scheduled.

Proposals are welcome from anyone associated with the Department: faculty, staff, APO staff, postdocs, and graduate students. There is no guaranteed time for any of these constituencies. If there is oversubscription for the time in any given quarter, proposals are evaluated and time allocated by the Observatories Committee. The criteria for ranking proposals include, but are not limited to: quality of the research proposal; success of previously awarded (in particular, as judged by publication); importance of proposal towards completion of a dissertation; and importance of proposal towards funded research or funding proposals. The balance between these is determined by the Observatories Committee and may evolve with time.

There is a user wiki for the telescope where users are encouraged to share information about the telescope and its instruments. This can be read by anyone; if you wish to post to it, you need to register for an account.

Much of the use of the ARC 3.5m telescope is done by remote observing, through an interface called TUI. Observers must be certified before they are allowed to observe remotely; certification involves learning how to use the telescope and understanding how it works, with a minimum of 3 nights on site. Generally, we try to train and certify all of our graduate students through an observing run done in conjunction with the ASTR 535 class. Training is the responsibility of the Department not of APO 3.5m staff members, although they can often provide much valuable advice and information.

#### **SDSS Telescope**

The SDSS project conducts several survey projects, and all department members have access to the survey products and to collaborations with the large SDSS community. The Department and University have invested a significant amount to participate in these projects, and Department members are encourage to take advantage of this participation.

#### **Other APO telescopes**

The NMSU 1m and the ARCSAT provide additional opportunities for research projects.

### 4.2.2 Sunspot Solar Observatory

The Department operates the Dunn Solar Telescope and the Visitors Center at the Sunspot Solar Observatory on Sacramento Peak, which is just adjacent to Apache Point Observatory. The facility is maintained by the National Solar Observatory, but NMSU runs the scientific/outreach operations.

### 4.2.3 Campus Observatory

The Tombaugh on-campus observatory is located next to the large student parking lot and neighboring running track just off of Williams Street. The observatory is mainly used for our undergraduate ASTR 105G and 110G labs and other public viewing events. Before using this facility, you need to be trained and checked-out on the equipment: a training session is generally scheduled by Tom Harrison at the beginning of the fall semester. Some online instructions can be found at

<http://astronomy.nmsu.edu/astro/observatory/telescopeguide.html>

There is a separate key for the observatory domes. Inside the dome, you can find another key hanging up that can be used to open the gate.

### 4.2.4 Tortugas Mt. Observatory

The Department has a 24" telescope in a dome on the north peak of Tortugas Mt (A Mt.), that is readily visible from town. This observatory was used significantly, especially for planet monitoring purposes, for several decades since its construction in the 1960s, but has been used little recently. We started an effort in 2010, in collaboration with the American Association of Variable Star Observers, to bring it back into service as a remote/robotic telescope. If you are interested in working on this project and/or using the telescope, contact Jon Holtzman.

Eventually, we have some hope to take advantage of this visible facility to help to disseminate information about research at NMSU, but details of how to do this are still somewhat murky!

## 4.3 Computers

All students should have a basic computer workstation on their desk. These computers run the Linux operating system (specifically, the RedHat/CentOS flavor of Linux). All computers are networked and there are central servers that host accounts and disks. As a result, if you have a department account, you can log onto any of the department computers; there are not individual accounts for individual machines.

Your desktop is meant to provide basic computer services like editing of files, web access, email access, image display, plotting, and the capability to compile and run basic programs. Many basic programs are installed either on each individual system, or centrally on the server disks, and thus accessible to all machines. However, the desktop computers are probably not optimal for significant computing.

If significant computing resources are needed for your work (e.g. more powerful/faster processing, more memory, etc.), there are several centrally located Department computers that are available via remote login:

machine	CPUs	Memory (Gby)	Dedicated usage
praesepe	48	132	Large jobs
hyades	48	32	Large jobs, better for parallel code?
virgo	64	64	Large jobs
henrietta			Finlator group
seismo	32	64	Jackiewicz group
solarstorm	48	132	McAteer group
milkyway	64	64	Holtzman group

There is also a campus-wide high performance computing facility, joker, that may be of interest.

If you feel that your work is being limited in any way by the computer setup, you should definitely discuss the issue, either with your advisor or the Department Head.

If you have any issues or questions about computing/software/etc, you should send them in an email to [issues@astronomy.nmsu.edu](mailto:issues@astronomy.nmsu.edu). This will ensure that they are documented, and will be seen by more than one person. We want to provide a positive computing environment, but can only do so if we know when there are issues/problems/questions.

It is OK to shutdown or reboot your computer using the menus on the login screen, but please let [issues@astronomy.nmsu.edu](mailto:issues@astronomy.nmsu.edu) know if and why you are doing this, so we can attempt to rectify any known issues.

Additional information on department computing can be found at <http://astronomy.nmsu.edu/computing>

### 4.3.1 External access

In an effort to decrease the possibility of computer security issues (hacking), we restrict login access from outside of NMSU to a single gateway machine, `astronomy.nmsu.edu`. You can connect to this machine from anywhere using the SSH login protocol. Once logged into `astronomy.nmsu.edu`, you can login to any of the individual nodes if you need to via: `ssh machinename`

### 4.3.2 Laptops and internet access

Many students now have their own laptops, which you can certainly make use of. To get connected to the network, you will need to first register your machine in the NMSU system. This is easily accomplished by pointing your browser to `netreg.nmsu.edu` (often, it will automatically be redirected there), and filling out the requested information (you'll need to know your `my.nmsu.edu` access information).

You can connect to the network with an Ethernet cable if there is a spare port in your office (if there isn't and you need one, talk with Jon Holtzman about possibilities) or via a wireless connection. The entire building has access to the AggieAir wireless network. There is also a wireless access point in downstairs in AY119, `astro-wireless-g`, and one upstairs in AY201, `astro-wireless-g2`. Both require a password, `NMSUAstronomy`, to access, but given AggieAir, these may be obsolete.

### 4.3.3 Email

Your NMSU email address will be `username@nmsu.edu`, where your `username` is chosen by you when you first access the NMSU `my.nmsu.edu` system; we set astronomy usernames to match the NMSU username. Email coming into `username@nmsu.edu` can be accessed via the `my.nmsu.edu` webmail system. However, many department members choose to forward mail from `my.nmsu.edu` either to a personal, external email address (e.g., gmail or whatever), or to a local address in the astronomy department (`username@astronomy.nmsu.edu`). You can set up automatic forwarding in the `my.nmsu.edu` email system.

If you use the `my.nmsu.edu` access or set up forwarding to an external email address, you should make sure than any email that might be sent to you internally from another astronomy machine will get to where you will see it. You can accomplish this by creating a file called `.forward` in your Linux home directory, and putting the email address to which you wish to forward your email into this file. **Don't** do this if you forward email from `my.nmsu.edu` to `username@astronomy.nmsu.edu`, or else all email will just keep bouncing back and forth!

### 4.3.4 Web pages

The department hosts a set of web pages at `http://astronomy.nmsu.edu` with a uniform "look-and feel". Instructions for how to establish and keep the contents of your department web pages can be found at

`http://astronomy.nmsu.edu/internal-info/website-how-to/`

You can also make personal web pages by placing files in `/home/httpd/html/username`, which will be seen at `http://astronomy.nmsu.edu/username`. Given that web pages have become a de facto way for people (including potential employers) to learn about others, you should keep your web pages up-to-date and professional!

### 4.3.5 Backups

Computers and computer disks do occasionally fail, so it is important to consider backing up important data and files. Within the department, we have implemented several disk-to-disk backup systems:

- on a daily basis, *small* files are backed up to a disk on a central server. Copies of small files are stored for a week, so these backups also serve as a short-term record if you inadvertently mess up one of your files.
- on a weekly basis, the *primary* disk on many of the workstations are backed up to a central server. Here, all files are backed up, but the backup from the previous week is not kept.
- **No backups** are done for *secondary* disks on workstations, nor of the large disk RAID arrays on several of the compute nodes. This is because we simply don't have the capacity to do so

See <http://astronomy.nmsu.edu/computing/notes> for some additional information.

It is important to recognize that disk-to-disk backups, especially within the department, are not foolproof. In an extreme example, if a fire or a hacker takes down the entire building, the backups will go along with the originals. As a result, it is always a good idea to consider whether you want to keep an off-site backup of your critical files. It is inexpensive to buy a USB disk that you can bring in occasionally, sync your files to, and bring home. If you require assistance, send email to [issues@astronomy.nmsu.edu](mailto:issues@astronomy.nmsu.edu)

## 5 DEPARTMENT TALKS AND EVENTS

Attendance at departmental and university-sponsored seminars is an important component of your educational experience (and will be so during your entire career). The department sponsors several seminar series. You are expected to attend whenever possible, even if you feel that the topic is outside of your immediate interests: our goal is to produce well-rounded graduates. Attendance offers exposure to topics you might not otherwise see, the opportunity to observe what characteristics make for a good or not-so-good seminar presentation (important skills to develop!), and the chance to make professional contacts which could be important in your future. Seminars should be well advertised with web page postings and email reminders.

### 5.1 Colloquia

Our most formal series is the Departmental Colloquia. These seminars are often presented by visitors to the department, and thus offer insight into work being performed elsewhere in the astronomical / planetary communities. These events are usually scheduled for Friday afternoons at 3:15 PM in BX102. Coffee, tea, and cookies are usually provided at 3:00 PM in advance of the talk. We generally schedule a round-table discussion between the speaker and graduate students immediately following the colloquium; attendance by students is expected, and this is a great opportunity to talk as a group with speakers about their interests and experiences in the field. When a visitor comes to town to present a colloquium, they are generally here for a full day at least, and we schedule slots for the visitor to meet with individuals. Students are encouraged to sign up for these slots, especially for students that work in a research area related to that of the speaker; this is a great opportunity to make some connections outside of the Department. There are also opportunities to talk with speakers in a small, less formal, group setting, by signing up to go to lunch or dinner (which also gets you a meal paid for by the Department!).

### 5.2 Pizza lunch

A less formal, but no less important, series is our Pizza Lunch. This series gives people an opportunity to present results in a relaxed setting. This can include presentations by departmental visitors, students ‘practicing’ a talk which they will give at an upcoming conference etc. One aspect of this series is the pizzas which are delivered prior to each meeting, thus the name Pizza Lunch. Slices of pizza are available at the cost of \$2 per slice.

We strongly encourage students to give one pizza-lunch presentation a year to update their committee and the department on the stage of their research, especially after you transition from classes to research. If you are taking research credits via ASTR 598 (see below), you will be expected to make a presentation as part of the class. It may be helpful to get formal feedback on pizza lunch presentations: if so, a template feedback form is available here.

### 5.3 astro-ph

Several times a week (twice) the Department gets together to discuss recent papers posted on the arXiv server (astro-ph). We try to limit these sessions to 30 minutes each, and cover two papers per session with a short presentation and discussion: presenters are asked to try to restrict presented materials to just 2 figures per paper.

Ideally, people skim the astro-ph postings, vote on those they find interesting, and volunteer to present on some. All Department members are encouraged to attend, even if not possible on a regular basis.

### 5.4 Inclusive astronomy

We have an Inclusive Astronomy group that meets weeks to talk about diversity and inclusion issues and initiatives, both within the Department and in the broader field. All Department members are welcome and encouraged to

attend, even if not possible on a regular basis.

## 5.5 Seminar class

ASTR 500, referred to as ‘Seminar class’, is a 1 credit class in which first and second year students registered each of their first four semesters. This class meets weekly, at which time one of the registered students will present a talk on material covered in an assigned paper. This paper is assigned by the faculty member overseeing Seminar for that semester. Generally, there will be a particular theme for the semester. These seminar presentations are open to the entire department, and faculty and third-year and above students are encouraged to attend and participate in the discussions.

Different faculty have different philosophies of what style of seminar is most beneficial, but the general idea of seminar is to get some exposure to subject material that may not be covered in classes, and to get experience with presenting material to a group of people.

## 5.6 Research group meetings

Some of the research groups have regular meetings to discuss a variety of topics within their research area:

- Planetary Group is a meeting where all department members interested in learning more about planetary science get together to discuss recent science results and mission highlights. You do not need to be doing research in planetary science in order to come and participate! This is a great opportunity to learn about recent science results that you can share with your undergraduate students, and discuss current planetary exploration efforts and policy issues with our local experts. It’s also a great opportunity to learn about results presented at recent planetary science conferences, and support department members preparing practice talks for such conferences. The Planetary Group meets bi-weekly; the meetings will be scheduled the week after classes begin.
- The solar group has also been known to have regular meetings
- A galaxies group has been meeting over the past several years, at which several papers (usually 2) are presented by someone and then discussed by the group.

Students can be the prime drivers of research group meetings, so if you are interested in something that isn’t happening, start it!

## 5.7 Tea time

We traditionally have held a tea time once per week, where different department members rotate bringing in some sort of treat for everybody to share, along with coffee and tea provided by the Department. Please sign up when the announcement goes out.

Tea time is an informal opportunity for people to get together and discuss any variety of topics.

# 6 ACADEMIC REQUIREMENTS AND POLICIES

The Astronomy Department offers a series of 500 and 600 level Astronomy courses which will provide you with much of the essential background needed for your research. You are also required to take one semester of ASTR 598 as a formal introduction to research. In addition, you have the option of taking some classes in graduate programs other than Astronomy, such as Physics, Electrical Engineering, Mathematics, Geology, Geophysics, Chemistry, etc. These course selections should be made in consultation with faculty advisors and career/research path plans.

If you take any undergraduate classes to supplement your background or address deficiencies, be aware that they will not count to your graduate degree course requirements. You should plan to review any undergraduate course work with your faculty advisor.

With the above outline in mind, we now consider the specific details of the academic requirements.

## 6.1 Course Offerings and Requirements

### 6.1.1 Astronomy Department Courses

The Department of Astronomy offers courses at the 500 and 600 level. Historically, the 500 level classes covered more basic areas and the 600 level classes more specialized, but this distinction has become quite blurred. All of the classes are 3 credit classes except as noted below. The course numbers and titles are as follows:

ASTR 500	Seminar (1 credit)
ASTR 503	Astrophysics
ASTR 506	Stellar Dynamics (formerly Astronomy & Astrophysics II)
ASTR 535	Observational Techniques I
ASTR 545	Stellar Spectroscopy
ASTR 555	Galaxies I
ASTR 565	Stellar Interiors
ASTR 575	Computational Astrophysics
ASTR 598	Special Research Programs (flexible number of credits)
ASTR 600	Predissertation Research (flexible number of credits)
ASTR 605	Interstellar Medium
ASTR 610	Radio Astronomy (also see 536)
ASTR 616	Galaxies II
ASTR 620	Planetary Science I
ASTR 621	Planetary Science II
ASTR 625	Cosmology
ASTR 630	Statistical and Numerical Methods in Astrophysics
ASTR 670	Heliophysics
ASTR 675	Star Formation & Stellar Evolution (not taught for a long time)
ASTR 698	Special Topics
ASTR 700	Dissertation Research (flexible number of credits)

Note that NMSU defines 9 credits as a full load, and students are required to carry this load every semester in order to qualify for employment as a teaching or research assistant. Students pay tuition according to the number of credits that they are enrolled in. For students in their final semester of dissertation writing, it is possible to petition the Graduate School for permission to enroll in only 3 credits, for that one semester only, to reduce tuition expenses.

As of 2013/14, we shifted to a core set of courses being offered every other year, mostly in the fall: ASTR 535, ASTR 565, ASTR 605 in odd years, and ASTR 506, ASTR 545, and ASTR 555 in even years. Certainly, first year students should plan on taking the fall courses that are offered, and most second year students will take them as well, although some second year students might consider a ASTR 598 during the fall semester.

As of 2019/20, we decided to offer an ASTR 503 every year, to be taken by incoming graduate students.

During spring semesters, more specialized courses will be offered on an every other year basis, with an intention of offering 4 choices each spring semester. However, since NMSU policy requires that graduate classes have a minimum of 5 students per class, there is a possibility that a spring class will not be able to be offered unless students distribute themselves roughly evenly between the courses that are being offered.

The courses are offered in *roughly* the following two-year rotation

Year, semester	Course	Title
Year A, Fall	ASTR 503	Astrophysics
	ASTR 535	Observational Techniques
	ASTR 565	Stellar Interiors
	ASTR 605	Interstellar Medium
Year A, Spring	ASTR 621	Planetary Science II
	ASTR 630	Statistical and Numerical Methods
	ASTR 670	Heliophysics
Year B, Fall	ASTR 503	Astrophysics
	ASTR 555	Galaxies
	ASTR 620	Planetary Science I
Year B, Spring	ASTR 506	Stellar Dynamics
	ASTR 545	Stellar Spectroscopy
	ASTR 616	Galaxies II

However, please note that the courses that will be offered in any given semester are subject to change, as we need to accommodate student interest, faculty leave, and other circumstances.

**If you have questions about course offerings, discuss them with the faculty: your advisor, the Department Head, First Year Advisor, or any other faculty member.**

### 6.1.2 Out-of Department Courses

Astronomy graduate students can (but are not required to) take up to two graduate level classes from departments other than Astronomy and have them count towards the degree requirement (of course, more can always be taken!). Traditionally, these have been in the area of physics, selected from the following list:

- PHYS 462 Intermediate Electricity & Magnetism II
- PHYS 511 Methods of Theoretical Physics I
- PHYS 551 Classical Mechanics (4 credits)
- PHYS 554 Quantum Mechanics I / PHYS 555 Quantum Mechanics II
- PHYS 562 Electromagnetic Theory (4 credits)
- PHYS 571 Advanced Experimental Optics (Lab, 2 credits)
- PHYS 576 Advanced Comput. Phys.
- PHYS 584 Statistical Mechanics
- PHYS 590 Nuclear Physics

Other courses students have recently selected instead of the traditional physics curriculum:

- EE528 Radiometry and Infrared Detectors (solid course on detectors and S/N considerations, taught from an engineering perspective)
- EE577 Fourier Methods in Electro-Optics
- CS579 Introduction to Computational Science May be an excellent course for students wishing to learn more advanced programming

Other Physics courses, or courses offered by other departments such as Engineering, Geology, or Math, are also viable as out-of-department courses. Additionally, for those students intending to specialize in planetary science, courses taught in the Geology department and Geophysics courses taught in the Physics department should be considered. Please discuss with your advisor/committee and the department head which out-of-department courses would best meet your needs.

The NMSU Computer Science Department does offer some 400-level programming language courses (C, C++, etc.). While these courses are generally offered at a level (< 500) below that required of our graduate students, taking these courses as an 'extra' course can be worthwhile since many of the Astronomy graduate courses and certainly student research require knowledge of a programming language, but these would not count toward the degree requirement.

## 6.2 Astronomy PhD Degree Program

### 6.2.1 Summary of Course and Credit Requirements

The MINIMUM course and credit-hour requirements of the NMSU Department of Astronomy toward completion of the Ph.D. program are summarized in the following table:



ASTR 500 (Seminar)	4 credits (4 semesters)
ASTR “regular” graduate classes (501-597, 601-699)	27 credits (9 courses)
Out of dept graduate classes OR ASTR graduate classes	6 credits (2 courses)
ASTR 598 (Special Research Programs)	3 credits
ASTR 600 (Pre-dissertation Research)	6 credits
ASTR 700 (Doctoral Dissertation)	18 credits
Minimum Total Credits	64 credits

Students *may* take two out-of-department classes to fulfill the overall credit requirements if these classes are deemed by the student and her/his committee to be appropriate to the student’s program-of-study. A maximum of one 3-credit course numbered between 450 and 499 can be applied to the out-of-department course/credit-hour requirement, but only with the approval of the student’s Committee. Otherwise, out of department classes must be at the 500 or greater level.

If more than 6 credits of out-of-department classes are taken, they *may* potentially count toward the required total courses/credit hours, but only with the approval of the student’s Committee.

### 6.2.2 Research credits

Several different course numbers involve research credits: ASTR 598, ASTR 599, ASTR 600, and ASTR 700.

ASTR 598 is generally taken sometime in the first five semesters (we recommend trying to schedule one during your second year) and is intended to provide a semi-formal introduction to doing a research project. It may or may not involve research that subsequently develops into a thesis project. As the first research credits, it is important to try to carefully consider goals and expectations for ASTR 598, in particular, to make sure that it does not fall secondary to the (perhaps) more immediate demands of formal classwork, teaching etc. You get a grade in ASTR 598 just like in any other class. To assist in making ASTR 598 productive, we have instituted some formal guidelines that you should discuss with your ASTR 598 advisor. These include:

- setting up, within the first two weeks of the semester, a schedule with milestones
- making sure that the research project involves background research on the topic, and not just analysis of some new data, techniques, etc.; trying to “do research” without a background of why it is interesting and important often leads to problems later!
- requiring a written report and an oral presentation of what has been accomplished at the end of the semester. It’s certainly fine if a project has not been completed, or yields no result; with the background research and the efforts made, it should be straightforward to provide a written and oral summary. Written reports may end up being very useful towards the development of a publication!

ASTR 600 and ASTR 700 credits are designed towards dissertation research. You may take anywhere from 1-9 credits of these in a semester. Generally, ASTR 600 credits can be taken before the thesis proposal is done, and ASTR 700 credits can be taken afterward. Specific milestones/requirements for ASTR 600 and ASTR 700 should be discussed with your research advisor.

If students end up working towards a Masters thesis, rather than towards a PhD dissertation, then they should enroll in ASTR 599 credits when working on the Masters thesis.

### 6.2.3 Special Cases and Exceptions

The above course requirements are intended for those students entering the Department with a B.A. or B.S. and a typical background in Astronomy and Physics. Some students may have studied Physics or Astronomy at the graduate level at some other institution and / or will enter the program with an M.S. degree. In these circumstances, some of the specific course requirements might be waived upon concurrence of the student’s committee. Students in this category must, before the end of their first semester with the Department, establish a special set of course and credit requirements with their committee.

Some entering students might have deficiencies in their academic background which would require their enrollment in advanced level undergraduate courses to remedy these deficiencies. These background or make-up courses must be taken in addition to the basic course requirements of the Department. That is, credits for these courses may not be used to satisfy any part of the Department’s course and credit requirements for the Ph.D. program.

### 6.2.4 Initial advisor and committee

Each entering student is assigned an advisor, usually matching the research interests of the student, if any have been expressed. There is no commitment on the part of either the student or the advisor that this needs to develop into a dissertation advising role. The advisor serves as a formal point of contact for students to have with a faculty member, but students are welcome and encouraged to talk with any faculty members at any time. We encourage students and advisors to meet at least briefly on a weekly basis.

We encourage students and primary advisors to discuss a mentoring plan and agreement, to make sure that both parties define and understand roles and responsibilities. This should be a “living” agreement, as it may change as student/faculty interests and outlooks may evolve.

We also identify a secondary advisor to provide an additional point of contact. We encourage students and primary advisors to include the secondary advisor in a meeting at least once per semester, possibly monthly.

A larger committee is required for the oral comprehensive exam and the dissertation committee. This usually includes three Department faculty members and requires one “Dean’s representative” from outside the Department. If you have taken courses outside the Department, that gives some possibilities for the external committee member. If not, your advisor can with getting an external member.

### 6.2.5 Departmental Examinations for Ph.D. Students

In successfully completing the program leading to a Ph.D. in Astronomy, a student will be formally examined and / or evaluated on three occasions:

1. The first is the Qualifying “examination” which is an evaluation of the student’s progress. This generally just involves a meeting with the initial faculty committee to discuss progress in the areas of cumes (see next point), classes, research, teaching, and outreach. Generally, if the student is making, good progress, he/she is advanced to Ph.D. candidacy, which means a slight increase in assistantship salary. **The qualifying exam meeting is generally completed at the beginning of the fourth semester, or earlier if good progress on the cumes is being made.**
2. Next is the Comprehensive Examination which involves three portions: written cumulative exams (cumes), an oral classwork exam, and an oral and written thesis proposal. In place of a single written comprehensive exam, the Astronomy Department offers a series of monthly written “cume” exams. Students are required to pass five of these exams within four semesters, starting the spring semester of the first year. After passing the cumes and completing classes, students take an oral classwork exam: **a good goal would be to complete this by the end of the fifth semester.** Finally, students present a written and oral thesis proposal to the whole department, which is followed by a discussion with the thesis committee: **a good goal would be to complete a thesis proposal by the end of the sixth semester.**
3. Finally, upon completion of the dissertation work, the student undergoes a Final Examination, which consists of a presentation of the thesis work to the Department, followed by a meeting with the thesis committee.

More details on these three evaluations are provided in the following sections.

#### Qualifying Examination

The intent of the Qualifying Examination is to determine whether or not it is in the best interest of the student and the department for the student to proceed with graduate studies in Astronomy. The Department of Astronomy does not give an explicit or formalized qualifying exam. In place of such an exam, the Department substitutes an evaluation of the student by members of the faculty. The Qualifying Exam must be successfully passed by all students wishing to pursue a Ph.D. in Astronomy.

As a part of the qualifying procedure, the student’s Committee on Studies will assess the student’s academic record, interest, ability, enthusiasm, research efforts, teaching efforts, and performance on the cumulative examinations (see below). A minimum of two ‘passed’ Cume exams is expected in order for a ‘PASS’ on the Qualifying exam to be achieved. This Qualifying Exam evaluation will be, in part, based upon the assessments of other members of the faculty. This evaluation of the student by her/his committee will normally be made following the completion of 12 credit hours of graduate-level course work for students entering with a B.S. or B.A. degree. Evaluation of students entering with an M.S. in Astronomy will normally be made at the end of the student’s first semester.

The student’s committee will make recommendation as to whether or not the student is qualified to proceed with additional PhD studies. If so, the student and the Graduate School will be so notified (i.e., the student will be

regarded as having "passed" her/his qualifying exam). If the faculty judge it to be in the best interest of the student and of the department, they may recommend that PhD graduate studies in Astronomy be discontinued. In cases in which the student's performance is judged to have been marginal, the faculty may require further written or oral examination of the student. Such further examination will be administered by the student's committee.

In the event of additional examination of the student, the Graduate Committee will recommend that either:

1. The Graduate School be notified that the Qualifying Examination has been passed and the student's PhD program of study be filed with the Graduate School; or
2. The decision as to the student's qualification be delayed or deferred one semester; or
3. The student be classified as having NOT passed the qualifying examination. In the last two instances, the student may ask that the faculty, as a whole, review the decision of the graduate committee.

## Comprehensive Examination

The comprehensive exam consists of both written and oral portions. The written portion is given in the form of cumulative exams (see below). To satisfy the requirements for the written portion of the comprehensive exam, the student must pass **five** of the cumulative examinations. This must be done prior to the oral portion of the exam.

### *Written Comprehensive "CUME" Exams*

The Department will administer nine written CUME examinations during each academic year: four in the fall semester and five in the spring semester on a  $\sim$  monthly basis. Typically, these are given on Saturday mornings throughout the semester. Students will start to take these exams starting their *second* semester, i.e. spring semester of their first year.

To satisfy the written portion of the comprehensive exam, students need to pass five of these exams by the end of their fifth semester, i.e. pass 5 out of 18 exams. Once five exams have been passed, students no longer need to take the exams. If the student does not pass the five CUMES on this time scale, then the student's committee will meet and decide between the following two options:

1. The student will be given a one semester extension to pass the remaining exam(s).
2. The student will be considered to have failed the comprehensive exam.

A student will not be permitted to take the oral part of the comprehensive exam until five CUME exams have been passed.

Students entering the program with a Masters degree may petition the Department to start taking CUMES during the first semester, but they would still be required to pass 5 out of 18 exams.

Each CUME exam will be written by a single faculty member (although input is usually solicited from other faculty members), who will not be identified in advance. The content of the exam is at the discretion of the faculty member but, typically, the exams are related to a short paper from the astronomical literature that is distributed with the exam, to test the ability of students to put the content of the paper into context, i.e. to understand the background of the subject, to be able to follow calculations and discussion in the paper, and to be able to discuss and work problems on related topics. These exams are designed to test the student's knowledge of the literature, the student's academic and research background, and the student's ability to understand and deal with what may be unfamiliar material. At least some of the material on the exam will be related to material discussed in the graduate curriculum.

When the CUME is based on a paper, the paper will be made available to students 30 minutes before the beginning of the exam, to provide time for the students to read it quickly and have a chance to think about the subject before starting the exam. During this reading time and the exam time, no other resources can be consulted, including web resources, discussion with other students, formulae in calculators, etc.

The CUME exams will be graded by the faculty member who developed the exam, with some degree of grade checking by an independent faculty member. Exams are graded on a numerical scale, and the faculty member identifies, sometimes in advance, the critical grade needed to achieve a pass on the exam. As far as completion of the five exams is concerned, passing is all that counts, not the numerical grade.

### *Oral Comprehensive Examination*

Once the student has satisfied the requirements for the written portion of the comprehensive exam (by passing five CUME exams), it becomes the student's responsibility to form a Dissertation Committee. Once a Dissertation Committee is formed, the student's Committee on Studies is dissolved and the Dissertation Committee will thereafter oversee the student's progress toward a degree. In selecting a Dissertation committee, it is expected that the student will first select an advising professor who will act as committee chairperson for the subsequent oral comprehensive and final examinations, as well as being the principal advisor in the dissertation research. The Dissertation Committee chair must be a member of the NMSU Graduate Faculty. The dissertation committee must consist of at least three members of the Astronomy faculty (including the Chair) plus one Graduate Faculty member from another NMSU department. Selection of a faculty member as a member of the dissertation committee requires careful thought on the part of the student, and approval by that faculty member. Also, Ph.D. Astronomers from outside NMSU can be nominated by the candidate for membership on the dissertation committee; the chairperson of the dissertation committee has the responsibility of approving such individuals following the guidelines established by the Graduate School. Such outside (non-NMSU) dissertation committee members do not replace NMSU dissertation committee members.

An NMSU Graduate Faculty member from outside the Department is required to be on the the dissertation committee to serve as the official Dean's representative. The Dean's Representative must be a member of the NMSU Graduate Faculty. Often this is a faculty member outside the Department with whom students might have taken a class; if you don't know anyone outside the Department, your advisor can assist with finding someone.

The comprehensive oral exam will be taken at the convenience of the student and the dissertation committee. It is the student's obligation to set a date and time satisfactory to all concerned. The examination consists of two parts described below. The student and her/his committee will determine the order in which these two parts will be administered; typically, the coursework exam is taken first (shortly after courses have been completed).

Part 1- General Questioning on Astronomy Course Work: The members of the dissertation committee together with a representative of the Graduate Dean's office will quiz the student to ascertain her/his knowledge of and familiarity with factual material, techniques, theory, and methods in Astronomy. The exam is expected to predominantly cover classes that the student has taken in the program, but can include any core Astronomy material. The level of difficulty and the nature of the subject material are up to the individual questioner. Part 2- Dissertation Proposal Colloquium: The student will present a colloquium to the entire Astronomy Department of the topic of her/his dissertation. The colloquium will include a discussion of previous research in this field, planned observations and/or theoretical calculations, scientific goals, and the impact of this research on the field. In addition, the student will prepare a written outline (typically 5-10 single-spaced pages long) of the proposed dissertation research for the committee at least one week prior to the colloquium. The student will describe the proposed research in enough detail so that the committee members will be able to judge the appropriateness of the proposed research. Following the colloquium, the student will be questioned by members of the committee concerning detailed background knowledge of the dissertation subject, and observational/theoretical techniques. If the committee views the dissertation proposal as satisfactory, then the student will continue with part 2 of the exam. If two or more committee members believe the proposal is inadequate, the student will be asked to revise the proposal and present the revised version at another meeting of his/her committee.

The formal completion of the oral comprehensive exam occurs when the second portion of the exam is taken (regardless of which order they are taken in). It is this final completion that is registered with the Graduate School. In order for this to be accomplished, the Graduate School must be notified about the date of the exam at least 10 days before it occurs. Forms must be completed in advance so that the necessary paperwork can be generated; see Ofelia for assistance.

Upon successful completion of all portions of the Comprehensive Exam, a student is eligible to receive a Masters of Science degree in Astronomy. To be awarded the degree, the student must complete an "Application for Degree" document, and an MS "Program of Study" document which WILL NOT include any ASTR 600 credits the student might have previously earned. The completed documents should be delivered to the Department Head who, with the assistance of the Department office staff, will oversee the delivery of the documents to the Graduate Student Services Office.

### **Final Dissertation Examination**

The Ph.D. candidate has up to five (5) years to successfully defend her/his dissertation after successful completion of all portions of the comprehensive exam (although two to three years is more typical). Upon completion of the dissertation, the candidate will schedule a final oral examination by his/her committee. Once again, it is the

responsibility of the student to schedule this exam on a day and time that is satisfactory to all members of the committee. The student will provide copies of the dissertation to all members of his/her committee at least three (3) weeks prior to the scheduled final examination. If the content is acceptable to the Committee, the Ph.D. candidate will then submit the appropriate forms to the Graduate School at least two weeks prior to the Final Exam (PhD dissertation defense) date. The dissertation defense will generally consist of an hour long colloquium presented to the entire department followed by a second hour or more of examination by the committee. The committee will then vote to pass, fail or adjourn as described above for the comprehensive oral.

Students should consult Graduate School documentation for official requirements and paperwork related to the dissertation. Three copies of the dissertation will be required (2 for library, 1 for Department); the advisor should be asked if he/she would like their own additional copy, but if so, the advisor will need to provide the funds for this extra copy. The Department would also like to get an electronic copy of the dissertation, which should be sent to the Department Head.

### 6.3 Masters Degree Program

Upon successful completion of the written and oral portions of the PhD comprehensive exam, it is the intention of the department that a student be awarded an M.S. degree in Astronomy. Other students may elect to pursue a Terminal Master's degree rather than a Ph.D. upon the advice of their committee. The rules for a Terminal M.S. are outlined below.

For the Terminal M.S. degree in Astronomy, the student must satisfy the requirements of the Department as well as those established by the Graduate School. The Department requires a minimum of 33 credits of which six are generally for Master's Thesis research.

A thesis is nearly always required for a Terminal M.S. degree. However, under some exceptional circumstances, the thesis requirement may be waived, in which case the credit requirements must be satisfied in formal course work. Such a waiver requires agreement by both the student's committee and the Department Head. In all cases, the student seeking a Terminal M.S. degree must pass a final oral examination covering course and any relevant research work. Any regular Terminal M.S. degree program will require a thesis.

#### Course Requirements

The MINIMUM course requirements for a Thesis MS will include:

ASTR 500	3 credits (3 semesters)
ASTR "regular" graduate classes (501-597, 601-699)	15 credits (5 courses)
Out of dept graduate classes OR ASTR graduate classes	6 credits (2 courses)
ASTR 598	3
ASTR 599	6
<b>TOTAL</b>	<b>33</b>

For a student who has decided and been approved to pursue a Course-work only MS Astronomy degree, the MINIMUM course requirements are:

ASTR 500	3 credits (3 semesters)
ASTR "regular" graduate classes (501-597, 601-699)	21 credits (7 courses)
Out of dept graduate classes OR ASTR graduate classes	6 credits (2 courses)
ASTR 598	3
<b>TOTAL</b>	<b>33</b>

If a student enters the Astronomy program with a M.S. degree in Physics, the Physics requirement may be waived and graduate courses in Astronomy, Mathematics, Computer Science, Engineering or chemistry may be substituted. In other cases, with the permission of the student's committee, graduate courses in Mathematics, Computer Sciences, Engineering, or Chemistry may be substituted for part of the Physics requirement. Upon making a decision to pursue only a Terminal M.S. degree, the student will form a Master's committee. In selecting a Master's committee, it is expected that the student will first select an advising professor who will act as Master's committee chairperson for the final oral examination, as well as being the principal advisor in the thesis research. The Master's degree committee must consist of at least two members of the Astronomy Department faculty plus one Graduate Faculty member from another NMSU department. Selection of a faculty member as a member of the Master's committee requires careful thought on the part of the student, and approval by that faculty member. A Graduate Dean's Representative will be appointed to the Master's committee by the Dean of the Graduate School. In almost all cases the out-of-department NMSU faculty member on the Master's committee will serve in this Dean's Representative

role. The Dean's Representative must be a member of the NMSU Graduate Faculty. The student is encouraged to consider a committee greater in number than the minimum requirement described above.

Upon completion of the thesis, the student will schedule a final oral examination by his/her committee. The exam will consist in part of a public presentation of the research conducted for the Thesis. It is the responsibility of the student to schedule this exam on a day and time that is satisfactory to all members of the committee. The student will provide copies of the thesis to all members of his/her committee at least three (3) weeks prior to the scheduled final examination. If the thesis content is acceptable to the Master's committee, the student will then submit the appropriate exam scheduling forms to the Graduate School for the Final Oral Examination at least two weeks prior to the scheduled exam date. The final oral examination for the M.S. will include questions related to the thesis research, and can also address basic principles addressed in the student's coursework. The Master's committee will then vote to pass, fail, or adjourn. If the committee votes to adjourn, the exam must reconvene within three (3) weeks of final decision.

NOTE: For students who decide to pursue a Terminal M.S. degree, but are thinking about possibly continuing for a Ph.D. degree once they complete the Terminal M.S. degree, it is important to:

1. continue to taking CUME exams if recommended by the student's Committee
2. continue taking courses so that they will not suffer unnecessary delays in meeting the Ph.D. course and exam requirements.

## 6.4 Academic probation

The NMSU Graduate School has policies about academic probation. Any student with a cumulative GPA below 3.0 will be on some level of academic probation. Once on probation, students MUST achieve a semester GPA of 3.0 to avoid going on academic suspension. In addition, there are restrictions on being able to take a full course load or being employed as a TA when on academic probation.

# 7 ETHICS

## 7.1 Professional behavior and a discrimination-free workplace

NMSU and the Department are committed to a harassment-free environment, The NMSU policy on discrimination, harassment, and sexual misconduct can be found at:

<https://equity.nmsu.edu/policies/>

Title IX of the Education Amendments of 1972 prohibits sexual misconduct, sexual discrimination, sexual harassment, and retaliation. NMSU does not discriminate on the basis of age, ancestry, color, disability, gender identity, genetic information, national origin, race, religion, retaliation, serious medical condition, sex (including pregnancy), sexual orientation, spousal affiliation or protected veteran status in its programs and activities as required by equal opportunity/affirmative action regulations and laws and University policy and rules.

While different people might have different ideas about what constitutes harassment, everyone in this Department is urged to adopt the most conservative definition and adopt an "always err on the side of caution" attitude and behavior. In particular, any behavior that might be considered to have sexual connotations, either physical or verbal, should be avoided whenever there is interaction between two people at different levels of authority, and even at the same level of authority, when interaction takes place in a professional environment. Specifically, there should be no such behavior between professors and students at any level, and there should be no such behavior between graduate students in a TA role and the students in their classes.

If anyone feels that they have been the object of insensitivity, discrimination, and/or harassment, they are encouraged, in the strongest terms, to report it. Such reporting can be to the Department Head or any faculty member in the Department; if you are a staff member, you can report to any supervisory personnel (including the Department Head). If you are uncomfortable reporting it within the Department, you can contact the Office of Institutional Equity (OIE) at [equity@nmsu.edu](mailto:equity@nmsu.edu), (575) 646-3635 (<http://equity.nmsu.edu>). Any such reports will be taken seriously. If you wish to report anonymously within the Department, a typewritten note in an envelope placed in the box of the Department Head (or box of any supervisor) would probably work well. Per NMSU policy, the Office of Institutional Equity should be notified of any reports of harassment, so if such behavior is

reported to you, you have an obligation to notify OIE; OIE will be notified of any reports made to the DH. See <https://equity.nmsu.edu/report-an-incident/> for information on reporting.

NMSU has also contracted with an external provider, EthicsPoint, to provide employees with an alternative anonymous way to confidentially report activities that are in violation of university policy, see <http://auditservices.nmsu.edu/report-line/>

If there are situations where you may have been uncomfortable, even if you do not think they have reached the level of harassment, you are encouraged to bring those forward as well; it is much better to discuss appropriate standards of behavior with people before it might potentially become a bigger problem.

Responsibility for acceptable behavior extends outside of NMSU whenever you are in a professional setting. The American Astronomical Society has provided information about sexual harassment and reporting for AAS meetings, and everyone has the right to feel comfortable at any professional meeting. See <http://aas.org/policies/anti-harassment-policy>

All Department personnel should be committed to making our profession free from discrimination/harassment and welcoming to all who are interested. Obviously to do so requires, at a minimum, individual behavior that is in compliance with policy. To make the community stronger, however, you can consider going farther by being a vocal proponent of a harassment-free environment. Awareness of and discussion about the issue are potentially powerful tools for improving the environment. It may be important for all of us to recognize, however, that different people have different comfort levels in how vocal they want to be on this issue.

## 7.2 Academic ethics

You should be careful to be ethical about the work you do and how you do it. At a high level, science depends on people being ethical about research: you need to faithfully report what you do and what you find, taking care not to overemphasize facts that might support a view that you hold while underemphasizing facts that do not.

On a lower level, e.g., vis a vis classes, we expect that you will behave honestly. On tests, we expect that you will not consult any material that you have not been explicitly told that you can, or attempt to look at the work of other students. Homework is perhaps a bit of a greyer area, as we encourage discussion of issues among students, while at the same time, expect that each individual student puts in sufficient effort to develop an understanding independently.

For some classes, solution sets may have been distributed to students in previous years for homeworks or for exams, and it is possible that some professors may use similar or identical questions. As a result, we expect that you will not make any effort to get or distribute previous answers.

When in doubt about ethical behavior, ask an appropriate person, whether that be the professor of the class, your advisor, or the Department Head! We have also had an “Inclusive Astronomy” group that has been meeting weekly to discuss related issues.

## 8 FINANCIAL ISSUES AND SUPPORT

To date, we have been able to support all of our graduate students financially throughout their time here. Most of our students are NMSU graduate assistants, where the assistantships can either be teaching assistantships (funded by the state) or research assistantships (funded by grants). In addition, some students obtain external fellowships that provide financial support.

### 8.1 Graduate Assistantships

NMSU graduate assistantships can be either for teaching (TA) or research (RA). The NMSU graduate assistantships formally cover 20 hours of work per week during the academic year. During the summer, when students are supported as RAs, there is some flexibility in the amount of pay that can be offered (20-40 hours per week). Note, however, that the primary requirement is getting work done, not counting hours. In fact, the summer hiring level more often varies because of grant funding availability than because of variations in the expected amount of work. If you want to succeed in the field, you will need to be working full-time!

It is more common for first and second year students to be supported as TAs, with more senior students supported as RAs, but exceptions to this certainly occur frequently depending on a number of different circumstances, including faculty funding levels, admissions offers, etc. While it may not seem fair to have different students at the same level



with different types of support, funding issues are a very real part of academic life, and, as you will subsequently learn, we all have to work within the framework of available resources, and this leads to different conditions for different people.

The Department generally considers that a student is “funded” if they receive total compensation that matches or exceeds the equivalent of 20 hours/week for the full year. If students receive fellowships or scholarships, that is included. In some cases, students receive fellowships on top of salary, but this is not the general expectation.

At NMSU, tuition fellowships are not routinely available, so students are responsible for paying tuition if this is not covered by a special fellowship or a grant. The Department recognizes that after deducting tuition, the minimum funding level does not provide an excessive amount of money, and continues to work with all relevant parties to improve this situation.

### **8.1.1 Teaching assistantships**

If you are working as a teaching assistant, the department head will assign TAs to different faculty/class sections based on peoples’ schedules, and when possible, faculty and student preferences. Feel free to make these known. Because of different teaching styles and course requirements, there is no guarantee that workload will be equal for all TAs, which is too bad, but will occasionally occur. If there seems to be a serious discrepancy, you should discuss it with the faculty member and/or the Department Head.

As noted above, there is a significant responsibility associated with being a TA, which includes both teaching and grading components. If you cannot meet these responsibilities, the Department may decide that it cannot offer you a TA position in subsequent semesters, which can have significant implications for financial support.

### **8.1.2 Research assistantships**

RA support generally comes from faculty research grants. These are written by faculty to funding agencies and, in general, are awarded with specific expectations of work that will be accomplished with the funding. It is extremely important for students to take their responsibilities as grant-funded RAs seriously. Not only are you being supported by public funds to accomplish research, but the ability of faculty to continue to be successful in obtaining future grants likely depends strongly on their ability to demonstrate success, as measured by concrete deliverables like papers, on previous grants.

You are encouraged to discuss research support with various faculty members at any time. Since research support is the only option during the summer, you will want to make sure to line up a source of support for summer well before summer comes around, i.e., you should consider and discuss this early in the spring semester.

It is your responsibility to plan, in collaboration with your research supervisor, how your dissertation research will be funded. The best approach is to identify, within your first few years at NMSU, a faculty member with grant support performing research in an area of interest to you. Begin working on a project with this faculty member (via ASTR 598 or 600) and demonstrate your abilities to him/her. Under the best circumstances, a dissertation proposal will emerge from this research and the faculty member will offer you an RA. Thus, it is important to identify a project which is of common interest to you and a professor, and that project should be supported by a grant.

### **8.1.3 Other funding opportunities**

Aside from faculty research grants, there are opportunities for students to apply for independent funding, as well as some funding fellowship opportunities that the Department can apply for. Students are strongly encouraged to be aware of, and apply for, independent funding opportunities. Some of these include NSF graduate research fellowships, NASA student fellowships (e.g., NESSF, ASTAR), NM Space Grant Consortium opportunities, as well as others.

Independent funding frees you from working on a subject that is covered by a faculty research grant, and helps out the entire department by making TA and RA funds available for other students.

In many cases, if a fellowship is awarded through NMSU, the University first deducts the tuition associated with the period of the fellowship, and only the remainder is available to the student.

The Department attempts to take advantage of all award opportunities it is aware of for eligible students. Some of these awards require that a FAFSA financial aid document be completed and available to the award-providing office. Thus, the Department encourages all students to complete and submit a FAFSA document at the start of each calendar year.

### 8.1.4 Residency

So long as you are employed as a graduate assistant, you are eligible for NMSU in-state tuition. However, there have been some issues in the past with getting in-state tuition if you are on an external fellowship. Because of this, *you should establish and apply for NM residency during your first year here*. Instructions for how to do so can be found at

<http://registrar.nmsu.edu/residency>

### 8.1.5 Benefits and policy

As an NMSU employee, you may need to be aware of official NMSU policy on a variety of subjects. Information on current NMSU policy can be found at <https://manual.nmsu.edu/policies-and-procedures/>

NMSU, like many other institutions, now requires all employees to participate in annual online compliance trainings. We request that you complete these in a timely manner after being notified.

## 8.2 Purchases and travel

There may be circumstances where you will want to be reimbursed for expenses, either for work-related purchases or work-related travel. You should definitely check with whoever will be funding these purchases (your advisor or the Department Head) **before** making the expenditure. Assuming the expenses has been approved, you need to submit receipts to Ofelia so that she can process a reimbursement.

If you work with Ofelia in advance, it is possible to purchase plane tickets directly without having to lay out your own money in advance. Note that, for reimbursement, receipts are required for meeting registration, plane tickets, hotel, etc.

When possible, expenses should be charged to the department credit card from which they can then be covered by charging an appropriate internal account, i.e. without requiring reimbursement at all. Ofelia and Lydia can help with credit card purchases. *The department credit card cannot be used to purchase airline tickets.*

Note that international travel requires pre-approval, see <https://ibp.nmsu.edu/international-travel-forms/>

## 9 INFORMATION AND COMPLAINTS

It is possible that you will run into problems at some point with either equipment or personalities. Here are a few individuals to contact for help in resolving these problems:

Building Issues/Problems	Ofelia Acosta or Lydia Medrano
Computer Issues/Problems	issues@astronomy.nmsu.edu / Jon Holtzman
Library Issues/Problems	Kristian Finlator
Laboratory/Observatory Issues/Problems	Zachary Edwards
APO 3.5m Issues/Problems	Nancy Chanover
APO 1m Issues/Problems	Jon Holtzman
Issues about:	
Other students	Jon Holtzman, Department Head
Faculty (any Dept.)	Jon Holtzman, Department Head

In conclusion, we hope that this guide will provide answers to many of your questions about getting started in graduate school. Clearly, each student will develop individual concerns and questions. We urge you to communicate with your advisor, the Department Head, and other members of the faculty to address any of these questions and concerns. Good luck!

\*The policies and procedures outlined in this guide are subject to change\*