The Astronomy Student Survival Guide

The Astronomy Students' Association
The University of Texas at Austin

Third Edition
Fall 1999

Table of Contents

Chapter 1

Introduction

1.1 Introduction

The purpose of this guide is to better inform the general astronomy student on what occurs within the astronomy department at the University of Texas. This guide contains information on classes, life as an astronomy student as well as general life at UT and helpful tips to create a better education experience while in college.

1.2 The Department

The UT astronomy department has two main functions. The primary purpose is to continually produce exceptional scientific research. Thirty-five professional astronomers, several research associates, and postdoctoral fellows as well as graduate students and a few undergraduates all combine to produce research in the astronomy department.

Professional astronomers come in two forms, professors and research scientists. The obvious difference exists in whether or not teaching is involved. Professors teach classes; research scientists do not. Faculty normally head a team of people working under and with them. This group of people usually consists of graduate students, undergraduates, post doctoral researchers and technicians. The advantage professors have stands in the financial support from the university. Also, professors may receive tenure which allows them lifetime job security with the university. Conversely research scientists must scramble for grants from federal agencies, and do not receive tenure. The bright side of working as a research scientist lies in the freedom to engulf oneself in research, as opposed to faculty who must also teach class. Both research scientists and faculty have the responsibility of presenting the results of their research to the scientific community through scientific journals (for example, "The Astrophysical Journal"), conferences and invited talks. For more information on the individual astronomers refer to Appendix A.

These are the people who conduct the research. Now for the methodical drive of scientific study. All science is based on data and information. In most sciences the data manifests itself through experimentation, whereas in astronomy the information comes from observation. Astronomers at UT carry out this research at McDonald Observatory. Perched on the summits of Mount Locke and Mount Fowlkes of the Davis mountains of west Texas, McDonald is one of the premiere observatories in the United States. The Observatory houses four research telescopes, including a 107-inch, an 82-inch, a 30-inch and the new, nine meter Hobby-Eberly telescope. Astronomers make trips to the observatory lasting several days, during which all research is done, after which they return home. Once home the scientist must analyze the data from the observations. Most of an astronomer's time consists of work done while seated before a computer, the ubiquitous research tool of astronomy.

The other purpose of the astronomy department is to educate students as well as the general public. First in line for education are the undergraduate students. Classes for both astronomy majors and non-majors are offered at UT. (You can read more about the individual classes later in the guide.) Other educational opportunities aside from classes are available for the students. The astronomy department has a mentor program. The mentor program matches undergraduates with graduate students at the university. The graduate mentor can serve as help for classes, someone to ask general questions about UT or simply a familiar face within the department. Also, students can seek advice from the advisors. The undergraduate astronomy advisor changes every few years. You can find the current advisor from the Student Office on the 15th floor of RLM. Also, assistance can be sought at the math, physics, and astronomy advising center on the ground (fourth) floor of RLM.

The astronomy department also keeps in touch with the community through public events and news programs. Every Wednesday the 16 inch telescope on the roof of RLM opens for public viewing. Friday and Saturday night the 9 inch telescope at Painter Hall is open to UT Personnel and to the public respectively. Also, the department promotes an audio magazine called "Star Date" which is devoted to astronomy and written in terms that someone who is not an astronomer can understand. This show is aired on 90.5 FM (KUT).

1.3 The Astronomy Students' Association

For those of you out there with an interest in astronomy as recreation and not just education the Astronomy Students Association (ASA) is the group for you. ASA's general purpose is to bring people together who enjoy astronomy. ASA takes trips to local telescopes, does community outreach with area schools, and gives you a place to meet other people with the common fascination with astronomy.

Chapter 2

The Astronomy Degree

Behold the Bachelor's of Art in Astronomy. Your key to a world of untold employment opportunity, high salary, and a carefree life. Well, maybe in a perfect world. The truth of the matter is it is a bit more complicated. Still, if Astronomy interests you, the degree plan is flexible, whether you want to be an astronomer or not.

The Astronomy department only offers a Bachelor's of Art. I have to tell people all the time I'm getting a B.A. in Astronomy and that always takes them aback. Well, that is just the way things are. The Department could only offer one degree plan and the B.A. is just less rigid and more versatile than the B.S. Actually, all you are getting is a Bachelor's of Art from the College of Natural Sciences with a major in Astronomy. Astronomy as a word will not appear on your Diploma. Sorry. Evidently, prior generations lobbied to change that but to no avail.

Now, why major in Astronomy? Well, because you love Astronomy. There are basically two types of Astronomy majors - those that want to go on to graduate school and become "Astronomers" and those who plan other career choices, even careers in Astronomy, but not taking the Graduate school track.

I want to point out here that college need not and perhaps should not be vocational training. The point of going to a university is really to expose oneself to new ideas and new ways of thinking. College has become a sort of prerequisite for a good job, indeed that is why today most people go to college, but this has not always been the case. Either way, your choice of a degree plan need not define who you are, or what job or career you will get.

With exceptions of course, any one can start any career with any degree. As for the university and its role in education... I encourage you to read Allan Blooms' *The Closing of the American Mind*. At least, try and look at the third part, about the university.

Back to the Astronomy degree. If becoming an astronomer, that is getting a Ph.D. and becoming involved in research, much like the professors and research scientists at UT, then the reason is fairly obvious. As an astronomy major, you put yourself at an advantage over other potential astronomy graduate students who only, say, get their degree in physics. Besides, the experience you can have in the department, the classes, working for a professor, etc. is a great deal of fun if you like astronomy, and want to make it your career.

After obtaining your degree here, another long stint of higher education awaits you in graduate school, where you will do research, assist whatever professor you work for in, write your thesis. Then, after the Ph.D., maybe a post-doc somewhere, and then finally, the holy grail - a faculty or research scientist appointment at a prominent astronomy department. But, that's not really undergraduate information, and this is an Undergraduate handbook. Besides, there's a whole chapter of this survival guide on Graduate School.

As for those who do not go on to graduate school, there are a wide variety of options. Since the astronomy department offers a B.A., you can tailor the degree in a variety of different ways. While obviously some courses are mandatory, other parts of the degree plan are quite flexible. You might want to take journalism classes and consider the possibility of science journalism. You might take computer science courses, as computers and computer programming are critical as support jobs for astronomy research. Perhaps Aerospace engineering interests you, and you could double major.

Even with just a BA in astronomy, since it is a problem solving discipline, there are lots of jobs you could find upon graduation. Don't think that whatever degree you pursue at UT will limit you or label you an astronomy major. Do you think all the philosophy majors in the world work at philosophy factories? No, in fact, they find jobs in all sorts of places, as do Astronomy majors. The high-tech sector, for example, is always having a hard time hiring, and people with degrees in problem solving areas like astronomy are considered highly trainable.

So, what is the degree like? Well, actually, there is not much to it. The degree requirements for a Bachelor of Arts are fairly non-restrictive. The goal is a well-rounded education, with lots of elective options. Pre-professionals (would-be graduate students) should take plenty of upper division physics classes and a healthy amount of math. If the solar system and the Planetary Sciences interest you, you can take geology classes and upper division geology classes instead of some upper division physics, since Astronomers who study Mars (for example, the scientists on the Mars Pathfinder mission) are really geologists at heart.

The following are the degree requirements for the major, taken and edited for space, time, and content from the online version of The Undergraduate Catalog, with running commentary in italics.

http://www.utexas.edu/student/registrar/catalogs/

Requirements for all BA's in the College of Natural Science:

Area A

English: English 306 and 316K.

Writing: In addition to English 306 and 316K, in taking courses to fulfill other degree requirements, each student must complete two courses certified as having a substantial writing component. One of these courses must be upper-division.

(One of these will most likely be PHY 453, Modern Physics I. The other one you can take at your discretion. Some suggest AST 350L, History and Philosophy of Astronomy. I'm taking Metaphysics in the Philosophy Department. A list of writing component classes appears in the front of every semester s course schedule.)

Foreign language: Students must complete four semesters in a single foreign language.

(Fourth semester proficiency is required. You can take correspondence courses, place out, or take accelerated classes with certain caveats.)

<u>Area B</u>

Eighteen semester hours, distributed among at least four of the fields of study listed below. None of the courses used to fulfill Area B requirements may be taken on the pass/fail basis. Courses in anthropology, geography, and psychology used to fulfill Area B requirements may not also be used to fulfill Area C requirements.

1.Six hours in each of the following fields of study:
- a. American government, including Texas government
- b. American history

(No surprise here. You have to take 6 hours of government and 6 hours of history.)

2.Three hours each from any two of the following fields of study:
- a. Anthropology
- b. Economics
- c. Geography
- d. Linguistics
- e. Psychology
- f. Sociology

(These can be fun. Sociology is cool. Take Physical Anthropology and make fun of all your creationist friends. Some of the Ethnic studies classes can be taken as Anthropology also, Mexican-American Culture for example.)

<u>Area C</u>

Fifteen additional semester hours, with no more than nine in any one department, from the fields of study listed below. No more than nine hours of mathematics and computer sciences combined may be included in these fifteen hours. Nine of these fifteen hours must be taken in courses in the College of Natural Sciences, items 1 through 9 below, with at least six hours in one subject; these nine hours may include no more than three hours of mathematics.

1. Astronomy
2. Biological sciences
3. Chemistry
4. Computer sciences
5. Geological sciences
6. Marine science
7. Mathematics
8. Physical science
9. Physics
10. Experimental psychology
11. Physical anthropology
12. Physical geography
13. History of science and philosophy of science

Students, counselors, and advisers are urged to make careful selection of Area C courses in order to develop a meaningful pattern and a coherent sequence.

(Reading the whole excerpt on Area C confused even me. These courses will be in your area of study, probably astronomy and physics, so I don't think you'll have to worry about them too much. The section on the Astronomy specific requirements fills all of Area C, for the most part I believe. Run degree audits frequently. The Interactive Degree Audit from the Registrar's Web Page is an invaluable tool.)

Area D

Six semester hours from the fields of study listed below. Three of these six hours must be chosen from sub-area 1, 2, 3, or 4 (excluding courses in logic).

A student who uses Greek or Latin to meet the foreign language requirement may use additional course work in the same language to meet the Area D requirement, but only upper-division courses may be used.

1. Architecture
2. Classics, including classical civilization, Greek, Latin
3. Fine arts, including art history, design, ensemble, fine arts, instruments, music, studio art, theatre and dance, visual art studies
4. Philosophy
5. Approved interdisciplinary courses including, but not restricted to, those in programs of special concentration cutting across specific departments, schools, or colleges. Lists of approved courses are available in the advising centers and the Student Division Office.

(A little fine arts. I think music classes are fun. If you play an instrument, there are plenty of non-stressful, laid back, non-music major ensembles to join, whether you prefer band or orchestra. Philosophy classes also can be interesting. Or any other fine art classes. You should take things that interest you to fulfill this requirement. It shouldn't be much of a pain. How left-brained can you be?)

Astronomy

Major: Physics 301, 101L, 315, 115L, 316, and 116L; nine semester hours of upper-division course work in astronomy, including Astronomy 352K and at least one of the following courses: Astronomy 352L, 353, 358, and 364; and six additional upper-division hours in astronomy and/or physics. No more than six of the hours counted toward the major requirement may be earned in conference courses.

(That's the basic introductory physics sequence. Plus the required astronomy courses. You'll take more physics and more astronomy than this most likely. Even beyond the "six additional" hours it mentions.)

Minor for astronomy majors: Six semester hours of course work (other than astronomy, lower-division physics, lower-division mathematics, and Mathematics 427K) approved by the undergraduate adviser; and either six semester hours of upper-division physics in addition to the courses used to fulfill the major requirement or six semester hours of upper-division course work approved by the undergraduate adviser.

(The minor is a bit odd. Six hours of something - anything (approved by the advisor, of course) plus six hours of physics or something else still? I never really understood that. Well, physics could be all twelve hours. It probably will be for many people. Or it could be none of the twelve hours. Let's assume six of them will be physics, though. It's not hard to use math courses for the other six. Just a minimal amount beyond what is required as a prerequisite for physics classes leaves you with upper division credits counting towards no other part of your degree.)

A grade of at least *C* is required in each semester of each course counted toward the major and minor requirements.

All astronomy majors should consult the astronomy undergraduate adviser regularly about the choice of appropriate courses in both the major and the minor. Qualified students may carry out a supervised research project in their area of interest under the departmental honors program.

(This is good advice. Stay advised. Run the aforementioned Degree Audits. Know where you stand.)

The astronomy major desiring graduate school should take plenty of physics. You'll probably take through Modern Physics II at least. Most take Modern III and IV as well, not to mention maybe Modern Optics and Thermodynamics. Also, math through at least Vector Calculus is needed to take all these physics classes.

The non-future graduate student has much more flexibility, and has to be more careful. The path is not so obvious, however. If you know what you want to add to your astronomy degree, be it a teaching certificate, programming skills, or journalism, be sure to plan out which courses will fulfill which requirements. Use your classes wisely.

However, don't be too worried if you don't have a firm grasp on what you want to do with your degree - that's normal. Also, keep in mind many students do not have majors, and that's somewhat normal also. Explore your options. Take electives early.

The Astronomy Department, in their Undergraduate Major Handbook, has recommended degree plans for majors and non-majors, but they are listed as only guidelines, and I will not reproduce them here. The handbook can be found on the web at

http://porky.as.utexas.edu/eso/ug.handbook.html

Chapter 3

Reviews

3.1 Class Reviews

This chapter is a collection of reviews from authors of the Astronomy Survival Guide who actually took the classes they are reviewing. So the stories here are non-fiction. We disclose our experiences here for you so that you know what to expect from the classes. But I want to remind you that the voices can be biased for various reasons, though we try not to be. Also how your courses are constructed heavily depend on which professors you get. Each professor has unique style of teaching, frequency of assignments and tests, and teaching philosophy. It will be easier for you if you are clear with your professor's uniqueness, and remember your professor is required to do so.

The review starts from physics, math, and astronomy, from freshman level to senior level classes. Many of classes reviewed here are the classes you will be most likely taking, though there are few optional courses. Some of them are required courses for astronomy majors, but some are for those who are majoring in both physics and astronomy, which is recommended (by many) if you want to be professional astronomer. We hope the reviews are helpful when you have to decide which classes to take, or how you can prepare for the classes.

3.1.1 Physics

PHY 301 - Mechanics

This course will be the foundation of your physics knowledge, and it is imperative that you not only learn the material but master it. If you had physics in high school, the concepts will look familiar: cannonballs, frictionless inclines, massless springs, ropes and pulleys, billiard balls, and the like. Regardless of whether or not this is new to you, do not underestimate its importance. You will use this knowledge in one way or another in all of your subsequent physics and astronomy courses. You must have good analytical skills in order to succeed in physics and astronomy, and this is where it all begins. Understanding the physical basis of an equation goes a long way in helping you solve problems. You must also learn how to manipulate those equations. Mechanics is also very visually oriented. You will be dealing with spatial relationships between physical objects, all of which have rules that apply to them. Work hard in this course, and keep in mind that everything you learn will actually be put to use sometime in the future.

PHY 101L - Laboratory Section for PHY 301

This laboratory section accompanies PHY 301. It is intended to lend some credence to the concepts you are taught in the lecture section by having you set up and run the actual physical processes. The 101L designation is misleading; you will spend considerably more time in the lab than one hour per week. Your lab manual will emphasize error calculations and the upkeep of your lab notebook. Making these tasks habit will save you effort and expedite the written work, thus giving you more time to play with the equipment and see how the physics actually works, which after all, is the point of this course. By all means, finish and turn in the written assignments, but don't get so bogged down with the details that you miss the big picture.

PHY 110C - Undergraduate Physics Seminar

This is a course your physics academic advisors will suggest for you to take when you talk to them before registration. I took it once about three years ago in the spring semester. When I took the class, it was for second semester freshmen who were in the E&M class. We were placed in groups of two students, each of which investigated a topic in E&M and made a presentation. Since we had to present what we learned about the topic, it deepened our knowledge and understanding of the topic.

This might be your first experience with giving presentations. There might be more than one topic you have to investigate, but when it s not your turn, you just sit in the classroom and listen to the other groups, so this is not a heavy load class. A few semesters after I took the class, I heard that it took a trip to a laboratory, which sounded pretty nice. I think this is an excellent class for freshman and sophomore students who are interested in physics.

PHY 316 - Electricity and Magnetism

This is the second calculus based physics class, taken after 310(Mechanics). I think the professor is rather important in this class, it can make a big difference. Honestly though, looking back after having had so many more advanced physics classes, this one isn’t that hard. The material is the basic properties of how charges interact; Coulomb’s Law, the electric field, Gauss’s Law, etc. Many of these laws have parallels in mechanics and concepts like energy and work from 301 you’ll rediscover in 316.

Also covered are basic circuits, and of course magnetism, and how all the properties relate to one another. Some of the circuit things you may remember from physics in high school. Calculating equivalent resistance and the like; although its obviously much more complicated hen presented here. You will have to integrate now and then, and there will be vectors. The integrals are not difficult to integrate, you just have to figure out how to set up the integral exactly.

The final section takes you into the world of AC circuits, in which the current alternates as a sine wave setting the stage for the wonderful world of PHY 315.

PHY 116 - Laboratory Section for Phy 316

The lab is well, a lab. I do not find then a great deal of fun. I'm not the lab sort, myself. Do the pre-labs, explain every possible source of error, and be meticulous. Don't use common sense when it comes to leaving things out, just put everything in. And be glad you're not going to be in a physics lab the rest of your life oh, unless you want to be a physicist and you like that sort of thing.

PHY 315 - Wave Motion and Optics (Waves)

This is the real deal, this is where your physics life truly begins. The first "real" physics class, and it s Waves. It's not like anything you've before, most likely. The nice thing about waves is that the various concepts are taught with both problems involving physical phenomenon, like say springs are strings, and AC circuits, where the oscillations may be a LC circuit, perhaps.

Differential Equations. Most people say you have to take it before this class, that it is absolutely vital to understanding. The course schedule does list it as prerequisite, although when I got to Waves I was told Diff. EQ could be taken concurrently.

I took Diff EQ the summer before I took Waves, and it was just at my community college back home. To be honest, none of the skills I learned in Diff EQ do I remember using in Waves. All the differential equations have some sort of standard form of solution and the class consists of finding various coefficients (amplitude, frequency, phase, etc.)

Differential Equations is useful though, if only so you're not seeing new things by the various- differential equations that will appear throughout the semester. Don't expect to use any Laplace transforms or variation of parameters to solve any equations, though.

Take the class in the fall semester, if possible. This is when Dr. Oakes teaches it and many people believe he is one of the best lecturers in the Physics department. Not to slight other professors who might teach Waves, but Dr. Oakes is in a class by himself.

PHY 115 - Laboratory Section for Phy 315

The lab for this class is pretty fun, as far as labs go. It's still three hours for an hour of credit, but the activities are interesting, and may actually explain some of the concepts you learn in lecture. Imagine that.

Remember what you learned in your other lab classes. Keep a neat notebook, follow your error carefully, etc.

PHY 336K - Classical Dynamics (Classical)

This is a course that reminds you of the importance of Newton s second Law. The Newton II appears everywhere throughout the semester. The course has three sections. In the first section, you will learn harmonic oscillator, which will be kind of review for you, and nonlinear oscillator. The next section will introduce you to Lagrangian and Hamiltonian. It was amazing to me when I worked on problems with those, and at the end, they just popped physical properties of particles in front of my eyes. The last section was used for rotation. You ll be able to solve the precession of rotational axis of the earth.

PHY 336L - Fluid Dynamics

This course is a survey of topics in fluid dynamics with an emphasis on actual phenomena observed in the lab. I found it a very interesting and casual class, though I wouldn't say that the material covered and the knowledge assumed were elementary. You should have a good understanding of vector calculus and differential equations, so if you did well in those classes, I think you'll be able to enjoy the fun part of the class. One of the best aspects of the course is that it is usually taught by a member of the Center for Non-linear Dynamics, which is one of the best, if not the best in the country. You can be assured that the faculty member teaching it has a vast amount of experience in fluid dynamics, and is aware of the very latest developments in the field. We even got to go on a mini field-trip to see a rotating couette apparatus right there on the 14th floor.

PHY 352K -Electrodynamics (Electro)

Electrodynamics will give you a theoretical background of electricity and magnetism, whereas your 316 class was much more circuit-based. Differential equations, vector calculus, and waves are necessities for this class and, depending on the professor, vector and tensor analysis can be useful. The professor will normally teach electrostatics (electric fields that aren't moving) first, then magnetostatics (magnetic fields that aren't moving) second, and end with a light touch of electrodynamics (electric and magnetic fields that move and influence each other) at the end. This class will often seem too easy and too hard simultaneously. You must know the material very well in order to keep off the bottom of the curve. It's importance to astronomy is that it will help you (maybe) later understand the magnetic fields of stars, which is a subject that has harried a large number of astronomers into a vastly gray and wrinkled state. Good professors for this course would be Dr. Markert and Dr. Fitzpatrick.

PHY 369 - Thermodynamics (Thermo)

This course gives an introduction to statistical mechanics, the study of heat and energy transfer processes on a microscopic level. When I took it, we were also given an overview of classical thermodynamics during the first half of the semester. This first segment very much resembled the thermodynamics portions of my high school physics and chemistry courses. The math required for this stage did not exceed the M 408D level. However, the stat mech section of the course was considerably more difficult. If you don't particularly enjoy math, this section won't be very comfortable for you. I would highly recommend taking probability before or concurrently with thermo. Overall, the course is more theoretical than conceptual, involving quite a bit of manipulating equations. Thermo isn't easy, but by the time you get to it, you can rest assured that none of your other classes will be, either.

PHY 453 - Modern Physics I (Quantum I)

Looking back, this is a fairly entertaining class. It will most likely be your first foray in the world of quantum phenomenon, and a few things, like say blackbody radiation, will remind you of AST 307 or AST 352K perhaps. Things do get more complicated though, I thought relativity (special of course) was cool and the formulae straightforward. It does get more complicated Rutherford scattering, the square well, and other less happy things. But, the class itself isn't that hard, say compared to the lab.

Now, if you like physics labs, you'll love the lab segment. Various famous and possibly Nobel Prize winning experiments are reproduced. The results usually demonstrate (surprise) the triumph of quantum theory over classical theory. (Although, for a moment in our relativity lab it looked like we had single-handedly vindicated Sir Isaac Newton and shown Einstein to be a fraud). You are allowed to choose the labs you'll do, and there is some number of write-ups you have to do in the semester. The relativity lab is pretty cool, you get to handle gamma-ray sources (stored in this cool lead sarcophagus) and make various jokes about radiation.

Astronomers should consider the solar spectra lab, which I did not do, but gets you up to the RLM 13th floor solar observatory where a helpful member of the Astronomy Department staff will assist you and your lab partners in taking a spectrum of the sun. Maybe you'll see a Ca II line. The lab, though, is incredibly time draining. Well, if you want to get through the class that is. The lab reports are to be long, thorough, include sections on the theory, procedure, data, and above all error analysis. The last item there, I don't think I ever understood it very well.

Don't leave the lab to the last minute. I say that knowing that you will anyway. And that I of course am famous for procrastination. If you must write the lab report 12 hours before it is due, at least do your error analysis, data analysis, and other computational things early.

This class is not that hard. But, it's not a "substantial writing component" for nothing, and that's where its difficulties lie. Future physics courses will seem different than this; more math and less writing. But at least this will most likely be your last lab (unless you're also a physics major).

PHY 373 - Modern Physics II (Quantum II)

In quantum mechanical system, matters have wave and particle duality. In order to deal with new concept of matters, this class will introduce you wave function Ψ, which depends on space and time in general. The wave function is not observable quantity, but it contains information about the quantum state. You ll learn formal mathematics that enables you to extract observable information. There are three most repeated problems in quantum mechanics: the square well, the harmonic oscillator, and the hydrogen atom. Then you get to perturbation theory, which is one method of approximation and is applied to those three problems stated above.

This is a key class, and if you don t learn the physics and math in this course, you will have very difficult time in the next quantum class (quantum III). As you work on problems, you will probably need to look for books besides textbook. Go to PMA library to search for good books.

PHY 362K - Modern Physics III (Quantum III)

This is a third class in modern physics, and it is an important quantum class for astronomy majors. This class is about multi-electron atoms and molecules. From first principles, you learn how to calculate the energy levels of hydrogen. Through approximations, you then get the energy levels of larger atoms, molecules, and solid crystals. Spectroscopy is a powerful method of observations in astronomy. From a spectrum of a star, you see lots of absorption and emission lines. A star is mostly made of hydrogen, but still there are many other heavy elements, which have more than one electron. If a star is cool enough, you will see lines from molecules. So it is the course where the abstracts of quantum mechanics meet the spectral lines of stars. The concepts are very difficult, but the math is not too bad, assuming that you learned about eigenvalues, eigenvectors, and operators in Quantum II.

PHY 362L - Modern Physics IV (Quantum IV)

This class is nothing more than a hodge-podge of known results from particle physics. There is not a specific direction or any fundamental understanding to be gained in this class. Yeah, it's kind of neat to see what's up with the particle physicists and there is quite a bit of useful information given in the course, but, it won't create much of an impact on your life.

3.1.2 Mathematics

M 408C/D - Calculus I/II

These are introductory math classes, therefore they are taught that way. Not very exciting, however, you'll need the material for a solid foundation in math skills. 408C introduces you to differentiation and integration. 408D covers sequences, series, and multivariate calculus. This class is somewhat more difficult than 408C, and will show up more frequently in later physics classes.

M 427K - Differential Equation (Diff E Q)

Differential Equations is an important class. Try to obtain a good theoretical understanding of differential equations, don t just learn how to them. It will help later on. You won t use much of what you learned in Differential Equations in Waves, but when get to Classical Dynamics, I think you find you need a somewhat better understanding of them than you got in Waves.

When you take Differential Equations, take a class where the teacher picks up the homework. It s too easy not to do the homework, if you don t have to turn it in. I would recommend not taking the class with Professor Bichteler. He doesn t pick up the homework and you also have to do these annoying projects with Mathematica. You end up spending more time learning Mathematica than you do learning differential equations. If you think you like this guy, take him, but if you haven t done the homework, the tests will be tough. If you can stand a teacher who speaks in a monotone, take Professor Friedman. He may speak in a monotone, but he does have a sense of humor and will sometimes joke in class or tell an interesting story. He also picks up the homework, gives reasonable tests, and does a decent job of teaching you differential equations.

M 427L - Vector Calculus (Vector Cal)

This is the last mathematics course you'll "have" to take; it's a prerequisite for several physics classes. You'll likely want to have one or few more upper division math classes for some of the other physics classes, but technically you can stop with this one.

This is calculus with vectors and matrices since the two are related. You'll do integrals with several variables, in several directions, on surfaces and line integrals. The class isn't too difficult, I think the professor I had was probably a bit easy though.

Towards the end of the class the useful theorems are learned - ways to convert surface integrals into line integrals and other useful things so that a complex integration becomes an integration over some surface or line that has a very simple geometry and a simple solution.

I've been told that Classical Electrodynamics is about "how good are you at vector calculus." I've not taken the course, but if you are going to keep that in mind as you take this class.

M 340L - Linear Algebra (Matrices)

Linear Algebra will seem simplistic and perhaps an insult to your intelligence. However, along with probability, it is actually the most important math class to understanding quantum mechanics. It is necessary for you to be able to manipulate operators and matrices and to understand eigenfunctions, states, and values. You will be expected to do quantum mechanics in a large number of your upper division classes and in grad school. Don’t cop out and take the class from someone who’s known for giving easy A’s.

M 362K — Probability

I suggest you to take this class before or with Quantum I. It is often said that quantum mechanics is a theory of probability. You need to understand what probability distribution means and how to get average values. Although the Quantum I textbook introduces you to the probability distribution, it is so much better if you ve taken a probability course before any quantum or statistical physics.

This course is not a difficult math class at all, but some of you might find it confusing. One solution to this is just to practice many problems. This works very well.

M 364K - Vector and Tensor Analysis (Tensors)

I really didn’t learn much in this class, but boy was it fun. I had the pleasure of learning from the infamous Dr. Guy. Guy is generally unintelligible and difficult to follow, but the homework assignments are straightforward and the exams closely follow the homework. Little emphasis was placed on applications of vector and tensor analysis techniques to "real world" situations; most of the course was simply an introduction to the range of mathematical tools available in the field. Although this class did little for me in terms of actual learning, I do know that vectors and tensors have wide applications in the field of modern physics. Therefore, it would still behoove you to learn the material, either from the textbook or by taking the course from a different and hopefully more coherent professor.

M 361 - Theory of Functions of Complex Variables (Complex)

I enjoyed Complex Analysis. I learned to think in a very abstract, mathese way in this class. I learned to get useful information out of dense material. I've never seen anything from this class again. I don't think I ever will and I don't understand why it is one of the recommended classes for physics majors.

3.1.3 Astronomy

AST 307 - Introductory Astronomy

Astronomy 307 is your basic introductory astronomy class. The homework and tests involve a lot of math, but it is all algebra and trigonometry, no calculus. You learn some new concepts and lots of vocabulary. There isn t much to say about this class, except be prepared to see some spherical trigonometry before you take it.

AST 104 - Introductory Astronomy Seminar

Every astronomy major or even any scientist interested in astronomy should take this at least once. It's a pass fail course in which you sit and listen to various guest lecturers discuss their research in Astronomy. Depending on the guests you'll hear about research from everything from galactic nuclei to magnetars to stellar abundances. All you have to do is show up, pay attention, and ask intelligent questions. Lots of fun. Take it if you can spare the time. It's only one hour a week.

AST 309 - Various Topics

The Astronomy 309 series is a non-major class. Majors can take those classes, but credits don t count toward to your degree. Prerequisites are AST 301, 302, or 303, which are not required for astronomy major students. Each AST 309 classes have a theme such as extraterrestrial life, stellar astronomy, cosmology, and galaxy. I believe organization of classes varies from one instructor to another. I took AST 309Q : Time and the Cosmos lectured by Dr. Ed. Nather in 1997. Since the material was so new, we didn t have a textbook. Instead we had a printed packet containing articles from various sources. The articles are not from Astrophysical Journal, and they are not technical. However, it is not easy to understand for the first time so that you have to read those articles very carefully, and if you don t understand, ask questions to instructor or TA. The AST 309Q started from the big bang and quasar, stellar formation and evolution, then stellar death (white dwarfs, neutron stars, and black holes). Dr. Nathar is a very good speaker, and I enjoyed being in the class. It was especially interesting when he talked about age determination of universe with white dwarf. AST 309 series are good to take for your electives.

AST 352K - Stellar Astronomy

If astronomers have a good understanding of any object in the universe, it would be of stars. We know quite a bit about stars — we have them well classified, understand them pretty much from life to death.

Given all this, it s not surprising that the stellar astronomy class here is a good one. Unlike other areas of astronomy where there are many unanswered questions, Stellar Astronomy is a well-developed field.

The course covers the kinds of data we can collect about stars from the radiation they admit. Blackbody radiation, absorption spectra, Doppler shifts of lines. Different types of stars are discussed as well, giants, dwarfs, variables. A portion of the class is devoted to star clusters, and what they have shown us about the galaxy. Also, stellar evolution — details about star birth and star death — is included. When I took the class, there was even some basic non-stellar astronomy, like coordinate systems and the celestial sphere.

I ve heard it said that some people skip AST 307 and take 352K as their introductory course. Well, 307 is offered every semester 352K every 2 years or so, so I m not sure how practical that is. And it s helpful to have had the overview of 307 before taking 352K, I think.

Even though it is a class on stellar astronomy, concepts learned in 352K apply across the board . and the class is rarely boring. Whatever kind of astronomy you choose to pursue, don t miss 352K.

AST 352L - Positional and Kinematical Astronomy

When you specify a position of, say a star, how can you specify so that everyone else can also specify the same location in the sky? If you use your local coordinate, people in Australia won t be able to find the star because their local coordinate is different from ours. Is the location of the star specified respect to the earth, solar system, or Milky Way galaxy? The first half of the semester was dedicated to learning different coordinate systems, different kinds of time, conversion of coordinate, and finally astrometry. Measuring position accurately is no simple task as it sounds. You need to be able to convert coordinate from one to another accurately; I have never taken any class which care more than 10 decimal points except this course. Conversion of coordinate is performed with quaternions, a form of math that deals with scalar and vector at once. It is amazing to see how much correction we have to make to account the effect from the atmosphere in order to do accurate astrometry.

When you discover a comet, you want to know its orbit and if it will hit the earth, right? The last half was used for orbit determination and few other kinematical topics including stellar motions. First you learn orbit in general in terms of time and space because you need position and velocity for orbit determination. Then the topics follow from perturbation theory, double stars, and stellar motions. If you have already taken stellar astronomy, you might know some of things in this part of lecture.

Over all, this course is very math-heavy class. They are very mean scary looking, however it is not too bad. You probably want to concentrate more on the concept and geometry in order to understand better. The material is very confusing, I found, and require you to think till you really understand how it works. Also you will get familiar with using Excel worksheet for the coordinate transformation with quaternions, and for the orbit determination with Laplace s method and Gauss method. I took this class from Dr. William Jefferys who generously spent time with students to help with problems.

AST 353 - Astrophysics

In Astrophysics you will learn how stars work from the inside out and how they work together. It is an important class for astronomy majors and there are usually good professors teaching the astronomy major classes. The only down-point is that the class may be filled with arrogant guys (from physics) who get testosterone rushes off of theoretical physics and astronomy and compare themselves to Weinberg and Hawking.

AST 358 - Galaxies

This course was created by Dr. Harriet Dinerstein, and she teaches it exclusively. Many different topics are taught, but the general format of the course begins inside the Milky Way and progresses outwards towards larger and larger scales, eventually ending up on the large-scale structure of the universe. Dinerstein spends considerable time and effort preparing her lectures, which are thoroughly researched and cited. Usually she begins with a qualitative description of a concept followed by its mathematical expression. Then she expands on it by giving examples from published journal papers, complete with charts of observational data. While a textbook is listed for the course, the majority of the material covered can only be found in the lectures. In other words, don't skip classes. Even though a copy of the lecture notes are placed in the library after each class, they are no substitute for the lectures. The homework assignments, unlike the lectures, are heavy on the math and involve quite a bit of analytical thinking. Fortunately, Dinerstein is very open to giving help, so don't be afraid to stop by her office if you're having trouble.

AST 275 - Journal Club

This course was created by Dr. Harriet Dinerstein for undergraduate students to learn how to read professional astronomical journals and how to give presentations. This is not an established university class, but treated as a conference course. If you want to take this class, you need to contact with Dr. Dinerstein for a permission to register for the class. The topic varies time to time. This class has offered twice in the past, and the first topic was about binary systems, and last topic was Gamma ray bursts. Although there is no prerequisite for the class, some astronomy background will help you, and you must have an interest in astronomy. Also this class is far from lecture classes you attend everyday; the class consists no more than 10 (there were 6 of us last time), and you are expected to participate in the class. The first few weeks is used to get general background about the topic along with discussion why giving effective presentation is important. You will probably give total of 4 talks per semester. The three of your talks will be related with the given topic, but the last talk is free topic; People picked their topic from cosmology to extra-terrestrial life. Besides giving presentations, another important thing is evaluation. For each talk, you get evaluations from everyone. In order to evaluate a talk, you have to know factors of a good talk and have to be objective, which you will learn in this course. Moreover, honest evaluation helps improve next talk for the speaker. In addition, there might be few guest speakers whose research is related to the topic.

My suggestions for this class are

1. Don't put off preparing your talk until the night before. Unless you are the expert of the topic, you will have many questions from the papers you read. If you start the night before, you won't have time to understand the material to give a talk about it at all.

2. Practice your talk at least twice. It is very important to time your talk. The format we used last time was 5-minute talks. You have to say everything in those five minutes.

3. The papers you read are not meant for undergraduate students. It's O.K. that you don't understand everything. This is one way of learning to get information you need to understand the material.

Overall, this class was very fun to be in, and everyone improved their presentations. It is highly recommended to take, and since this course is not given periodically, if you know it's offered next semester, there is no question you should go ahead to talk to Dr. Dinerstein!

AST 376 - Astronomical Instrumentation

I have to admit, I signed up for this class knowing it would be different, with elements of engineering and working on a project. I was not sure if I'd like it or not. However, by the end, it turned out to be a very good class. Highly recommended.

Instrumentation is nothing like your typical lecture type class. The goal of the course is to design and construct a working astronomical instrument. When I took the class this was a scanning monochromator, a type of optical spectrograph. I'm uncertain if the project will change in the future. Regardless of what type of instrument is to be built, I imagine the course will follow a similar line. Building any astronomical instrument is very interdisciplinary. The skills involved include machining, mechanics, optics, electronics, and interfacing. Thus, you will find many non-astronomy/physics majors taking this class.

The class is divided up into teams and groups. Each group, every 2 weeks or so learns a different segment. In the optics segment, for example, you learn basic optical layout, what f/ratios and f/stops are, the basics of the thin lens equation and how to use computer ray-tracing software. Other segments include mechanics (in which you'll go into the machine shop), interfacing (getting to know LabView), and electronics (a bit of EE stuff here; filters, op-amps, some circuit design, and learning to use Circuit Maker).

While the EE or the optics might scare you off, none of the material is very difficult and I think the textbooks for the class, especially *The Art of Electronic Design* by Horowitz & Hill, are very good.

After you've met in groups for a few weeks, you begin to meet with your teams. The idea being that at least one member of the team will have done one of the 4 sections so that between the 4 or 5 of you, all the sections will be covered.

You then have to decide how to build and lay out your instrument. What the moving parts will be, what optics you'll choose, what parts you will need, etc. As the class moves towards its end, you'll work with your team to get all aspects of the project working.

You have a deadline, so expect a few late-nights, especially toward the end. The important aspect of the class is a sound design, not necessarily having the instrument work perfectly. Having a professor who is an instrumentalist and has seen projects fall behind schedule or not demo properly the first time (in my case Dr. Jaffe) helps.

The class meetings consist usually of meeting with your group or team, and discussing when you'll need to meet outside of class. Occasionally, there will be lectures about a certain segment that will help with the assignments associated with the various segments (optics, electronics, etc.)

In short, even if you know you're not going into instrumentation, you should take this class. It's quite an experience.

Chapter 4

College Life

4.1 Life at UT

Introduction

In the course of your college career, you may find that your life follows a certain pattern or cycle of highs and lows in the way that you feel during a period of time. This is normal. However, that is not to say that it cannot be avoided. Indeed, it is my hope that by presenting the information in this guide I can help avoid or otherwise deal with the isolations, the stresses, the blues.

The cycle of the college student exists on a yearly scale; it is unrelated to specific stages within the year. It has its basis in experiences common to most college students. The phases of the cycle may sound negative, but that is because I want to point out what to avoid. I pass this information on to you in the hope that you will learn from my experiences.

Freshman Isolation

You've just entered a university with a student body of fifty thousand. Despite that fact, you still feel isolated. You have very little in common with most of these people, the majority of whom you will never meet anyway. You may make some immediate acquaintances in your classes or dormitory, but it is too early to count them as friends. You are surrounded by fifty thousand strangers.

This is the best time to explore. The university has an astounding number of student organizations you can join. Any particular type of interest you have will have an associated student group. Go out and find it! Meet the people you know feel the same way you do. Get involved. This is the stage when lasting friendships are forged. Student groups flourish at UT simply because no other consistent path exists for students with similar interests to meet one another at a university of this size.

Don't limit yourself to the university, either. Austin abounds with organizations of a wide diversity. Even if you are only here for four years (more or less), you can meet quite a few interesting people that share your outlook. In a word: explore.

Sophomore Slump

You have completed your introductory courses (hopefully) and are beginning work on the first of your degree requirements. Your grades for your first year of college were satisfactory, if not spectacular. You begin the move to higher level classes such as Phy 316 and Phy 315. Quite soon you learn to lower your expectations. You set out with the intent of conquering the intermediate physics and math courses and end up simply trying to survive them.

The widening gap between expectation and outcome can be dealt with. You must work harder. That may sound condescending, but you must realize as soon as possible that you cannot maintain the grades you achieved your first two semesters with the same level of commitment. The sooner you accept this inevitability, the sooner you will benefit.

Get to know your professors. The conventional structure of the lecture does not include this option. You must take the initiative to make it happen. Despite the common perception to the contrary, most professors are very willing to offer their help. Don't hesitate to ask. Also, don't forget that professors are more willing to discuss a course grade if they know who you are. You might even become good friends with some of them.

Keep in mind that you are not alone in the sophomore slump. The majority of your peers will also be suffering. You need not worry over being left behind.

Junior Stress

As you move deeper into the chaos of your classes, a new isolation sets in. You have less and less time to spend with friends. Most likely they find themselves in the same predicament. You spend most of your time studying physics and astronomy. The situation is compounded if you are working a part-time job. No time exists to even think of finding an outlet for the tension and stress you feel. You stay up late to work on papers, labs, homework, and studying for tests. You find yourself consuming ungodly amounts of coffee and ordering late-night pizzas several days in a row.

It may not be quite this bad, but then again, it could. The only advice I can offer is to simply learn how to deal with the stress. Of course that's easier said than done; I don't deny that. But one way or another, you need to figure it all out. Many resources are available at the university to help you cope. You can talk with a counselor or attend a seminar on stress or time management. Or you can take a day off away from school and simply relax. And don't forget those very friends whom you've forsaken. They, more than anyone else, know what you're going through. Many options exist. Take advantage of them. Anything is preferable to a mental breakdown.

Senior Depression

This is the point where paths diverge. Some of you may choose to start working towards attending graduate school. Others look forward to using your soon-to-be-awarded degree in finding a job immediately upon graduation. Still others face the possibility of a fifth year (and possibly more) at UT. Some simply feel like getting this whole damn thing over with and working full-time at that local bike shop.

Whichever category you fit into, the common experience remains. Things are changing, and despite our greatest efforts, they'll never be the same. Everyone is about to go their own separate way. You went through this very routine four years ago when you graduated from high school, and you make the promise to yourself that this time will be different. You tell yourself that you'll keep in touch with all of them, but somehow you know that won't happen.

The cycle is familiar, and it certainly won't be the last time you'll experience it. Friends are made, and friends are lost. It's a lifelong process. Through it all, however, there are always constants. You may be saying goodbye to friends, but the memories of your times together will always remain. And there will always be those with whom you will never lose touch. That in itself is no small consolation.

Keep this in mind as you move on. Things change, and we fight it, but when we really stop to think about it, we find that we welcome it. Given the choice between routine or change, most of us would choose the latter. Goodbye and good luck.

4.2 Financial Assistance

While UT is cheaper than many other universities of comparable quality, the cost of a four (sometimes five, six, seven....) year education at UT can put a dent in anyone's pocketbook. For the 1999-2000 school year, the estimated cost for undergraduates is $8,474 for students living at home, $12,378 for students living on campus, and $13,446 for students living off campus. As tuition, fees, and rents continue to rise on an annual basis, you must be nuts or filthy rich not to take advantage of the millions of dollars of financial assistance available at UT.

Non-need based financial assistance

Contrary to popular belief, you do not have to be dirt poor to qualify for financial assistance. There are a wide variety of financial resources available to all students, regardless of their income bracket.

1. UT-Austin Short Term Emergency Loan
   Any student enrolled at least half-time at UT-Austin can apply for emergency loans through the TEX phone system. To apply for these one-month cash loans or two-three month tuition loans with a 4% annual rate, call TEX 512-475-9950, and choose option #33. For more information, call TexTalk at 512-475-9950, option #91, and choose codes #18095 and #18100.

2. Commercial Education Loan Programs
   Numerous agencies and companies provide privately funded educational loans. Go to the Office of Student Financial Services to pick up the handout "Commercial Educational Loans" for more information.

3. Student Employment Referral Services (SERS)
   The SERS has set up a new student employment system (JAM! - Job and More!) to help students currently enrolled at UT find part-time jobs with employers, internship sponsors, and volunteer organizations. JAM! can be accessed 24 hours a day, seven days a week at
   www.utexas.edu/student/finaid/JAM!/index.html

4. Scholarships
   The College of Natural Science offers several scholarships. Contact Shirley Reed, Scholarship Coordinator for the College of Natural Sciences, for more information.

   Shirley Reed
   Office of the Dean
   WC Hogg 3.104
   Austin, TX 78712-1199
   512-471-3285
   512-471-4998 FAX
   SReed@mail.utexas.edu

   Visit www.utexas.edu/cons/student/scholarships/ for more scholarship information.

The Astronomy department also offers scholarships to upper division undergraduate students. An e-mail will be sent to notify all eligible students during the spring about Astronomy department scholarships. Contact the undergraduate advisor for more information.

The Office of Student Financial Services distributes many scholarships. Entering freshmen should fill out the Application for Freshman Scholarships by December 1, continuing or transfer students should fill out the Application for Scholarships for continuing/Transfer Students by March 1. Both forms are available at the Office of Students Financial Services. You can also make an appointment with a financial aid advisor to learn more about scholarships available at UT.

Graduate Programs

1. Fellowships
   In order to be eligible for a fellowship, a graduate student must be nominated by his/her graduate advisor. Contact your graduate advisor or the Office of Graduate Students for more information. If you relieved federal/state financial aid, contact the Office of Student Financial Services to find out if receiving a fellowship will affect your financial aid package.

2. Teaching Assistantships
   Contact your graduate advisor to apply for a TA position. Nonresident and international students who hold assistantships may be eligible to pay resident tuition rates. If you relieved federal/state financial aid, contact the Office of Student Financial Services to find out how if receiving a TA position will affect your financial aid package.

Need based financial assistance

Many students don't even bother applying for financial aid because they believe that "my parents make too much money to qualify for financial aid." While it is true that federal and state grants are only awarded to students with high financial need, most students who apply can qualify for federal and state loan programs.

Which would you rather do: 1) Spend a few hours filling out an application to see if you qualify for thousands of dollars in financial aid OR 2) Try to find a part-time job that barely pays over minimum wage to fit into your already hectic schedule of 12 plus hours of classes and a hopefully active social life.

To apply for financial aid pick up the Free Application for Federal Student Aid (FAFSA) at the office of Student Financial Services, located in the Student Services Building room 3.200. Since the funds for financial aid are limited, the sooner you turn in your application, the better your chances are of getting financial aid before the funds run out. Applications are accepted after January 1st. Do not mail in your form before then or the application will be rejected. UT's priority deadline for applications for Fall/Spring semester is March 31. Applications will be accepted after the deadline, but the chances of getting financial aid is smaller the longer you wait to turn in your application.

1. Grants

   Grants are awarded to students with high financial need who turn in their applications before the priority deadline. If you qualify for grants, DO NOT turn them down. Grants are the absolute best type of financial aid because you never have to pay them back (unless of course you lied on the financial aid application, which I really suggest you avoid since they can make you pay back the money, fine you and throw you in jail). Grants are even better than scholarships because you don't' have to write a long, tedious essay about why you deserve the scholarship.

2. Scholarships

   While most university scholarships are based on merit, some scholarships do take financial need into account.

3. Work Study

   Work study funds are given undergraduate who show a financial need. Work study jobs are mostly on-campus, but there are off-campus jobs available. The advantage of a on-campus work-study job over a regular off-campus job is that on-campus employers can be more understanding and flexible with your schedule since they know your top priority is your school work, not your job. Students will work 10 to 15 hours each week.

4. Student Loans
   Nearly every student who fills out the FAFSA will be able to qualify for loans.

Need-Based, Federally Subsidized Loans

The federal government pays the interest on the subsidized loans as long as you are enrolled half-time, as well as up to six months after you are no longer enrolled half-time. Students should choose subsidized loans over unsubsidized loans in order to save on the interest charges.

- Federal Perkins Loans - given to undergraduates and graduate students with very high financial needs. These loans don't have to be repaid until six months after you are no longer enrolled half-time. These loans have the lowest interest rates.

- Federal Subsidized Stafford Loans - given to undergraduate and graduate students with financial need. These loans have a higher interest rate than Perkins loans.

Non-Need-Based, Unsubsidized Loans

Most financial aid applicants at UT receive unsubsidized student and parent loans. For unsubsidized loans, interest begins to accrue as soon as the first loan funds are given to you. Unsubsidized loans are more expensive than subsidized loans since the interest rates are higher and interest charges start as soon as you receive the funds. Students have the option to defer payments on the unsubsidized loans until after they are no longer enrolled at least half-time, except for parent loans.

- Federal Unsubsidized Stafford loans- given to undergraduates and graduate students, regardless of income level.

- Federal parent Loan for Undergraduates - given for the parents of dependent students.

- College Access Loan - given undergraduate and graduate students who pay Texas resident tuition rates, have good credit history, are in good academic standing, and can obtain a credit-worthy co-signer.

For more information about financial aid, check out the office of Students Financial Services Home page at www.utexas.edu/student/finaid/ or visit the Office of Students Financial Services in the Student Service Building on the 3rd floor, room 3.200 or call the office at 512-475-6282 .

4.3 Housing

Picking a place to live is one of the most important, and at times the most frustrating, decisions that you will make during your college life. Each type of housing option has its own advantages and disadvantages. When looking for a place to live, you should choose the option that best fits your needs. Some students prefer the convenience of living on campus, others prefer the freedom and responsibility of living in apartments, while others prefer the low costs and democratic nature of cooperatives. The more research you do, the better the chances are of finding a place that best suits your personality.

Basic Housing Options

1. On-Campus Dorms

   The Division of Housing and Food Services operates 10 dorms that house over 5,000 students. Starting in Fall 1999, 70% of the spaces in the dorms will be reserved for incoming freshmen. The other 30% is reserved for the RA (resident assistants), athletes, upper class students and transfer students. The 70/30 plan was developed to encourage incoming freshman to live in the dorms in order to help them adjust to college life.

Applications are available at The Division of Housing and Food Services, located at 200 West Dean Keeton Street or you can download a copy of the application at www.utexas.edu/student/housing/halls/application.html. There is a $35 nonrefundable application fee. You must be a full time student to live in the dorms.

Reasons for choosing on-campus dorms

a) Cost

   -Living on campus is generally cheaper than living off campus.

b) Convenience

   -Classes are only a few minutes walk away.

   -Paying the rent is your only responsibility. When you live off campus, you worry about various other details, such as utilities, groceries, cleaning, etc.

c) Social interaction

   -Dorms offer the opportunity to meet and socialize with other students.

For more information about on-campus housing visit the Division of Housing and Food Service web site at www.utexas.edu/student/housing/residence/index.html or visit their office at 200 West Dean Keeton Street or call them at 1-512-471-3136.

2 Off-Campus Private Dorms

Off-campus dorms serve as option for those who don't want the rules and regulations of on-campus dorms, but aren't yet ready for an apartment life. They offer some of the same benefits as UT dorms such as meeting other students and lack of "responsibilities". They also offer other benefits that UT dorms do not, including larger rooms, maid service, swimming pools, etc. The main disadvantage of private dorms is their cost; they can be thousands of dollars more expensive than UT dorms. The prices, amenities, and configuration and sizes of rooms vary from dorm to dorm, therefore you should contact the various dorms for specific information. For a complete listing of private dorms in Austin, visit the Austin Private Dormitory Association website at www.austindorms.com. The site gives the rental rates, amenities, contact information, etc. of the nine private dorms in Austin (Castillian, Contessa, Dobie Center, Goodall Wooten, Hardin House, Scottish Rite, University Towers, Madison House, Texana).

3. Renting an Apartment or a House

The best advice for selecting an apartment or a house is to start early. The earlier you start, the better chance you have of finding a place that you like and is in your price range. It is possible to wait until the last minute to find an apartment or house, but you might get stuck with a place that is in bad condition, too expensive, or too far away from campus.

Steps for selecting a house or apartment

a. Before you start looking for a place to live, you should make a list of what you are looking for. Do you plan to live alone or with roommates? How many bedrooms and bathrooms do you need? How big a complex do you want to live in? Do you need to live close to a bus route? How much are you willing to pay? Do you want a furnished apartment with all bills paid? Do you want to live close to campus or far away? What sort of neighborhood do you want to live in? Do they allow pets? The list can help you and an apartment locator find a place that will suit your needs.

b. There are various ways to find a place that will meet your needs. You can ask your friends about where they live. If you visited a friend's apartment that you like, then ask them for more information. They can give you their honest opinion about places that they have lived at or places where "a friend of a friend" have lived.

You can also look in the classifieds of the Daily Texan, Austin American Statesman, or pick up a copy of the

"Apartment Guide." The Apartment Guide is a free monthly magazine available in certain stores and alongside numerous newspaper vending machines.

A third option is to use an apartment locator. An apartment locator tries to match your needs to their list of available apartments. Since each locator service has a different list of available apartments, you might contact more than one agency. You can find a locator by using the phone book or by asking friends who have previously used one.

Locators will frequently try and send you to larger complexes, many near Riverside. If you want a smaller complex, you ll probably have to look on your own.

c. Once you have selected a few places that are in your price range, then visit and research the places further. If you pay the utilities, ask how much are the monthly utilities. While the monthly rent for apartment A may be lower than apartment B; when you add in the cost of utilities, apartment A can end up costing more than apartment B. If possible talk to current residents about the atmosphere and safety of the apartment complex and of the neighborhood. Also ask the tenants about the landlord. Some landlords are quicker to respond to complaints than other landlords. While the quality of the landlord does not seem that important, it will become very important when your apartment is infested with ants even though you have told the landlord on numerous occasions about the ant problem.

d. After you have made your final decision, it is time to do the paperwork. The most important advice is to thoroughly read the lease before you sign it. Make sure that you understand the conditions of the lease. If you have questions about anything in the lease, ask them. This is not the time to be shy. You might even ask your parents, relatives or friends who have some experience in renting properties to read over the lease. They might notice questionable clauses in the lease that you might have overlooked, especially if you are a first time renter.

4. Cooperatives

Unlike dormitories, the students living in co-ops are in charge of running and maintaining their living environment. House members share cleaning, cooking and administrative responsibilities to ensure that the house runs smoothly. During the periodic house meetings, every member has a vote in deciding house policies. Since the goal of the non-profit co-ops is to provide housing for its members, not to make as much money as possible, the rents are relatively low. The atmosphere, cleanliness, number of residents, number of meals and chores, amenities, personalities and amount of nudity varies from co-op to co-op. You should take a tour of each co-op to find the one that best suits your personality.

There are two main co-op organizations in Austin. The College Houses run five co-ops in West Campus (Pearl Street, Taos, 21st Street, Laurel House, and Opsis.) Contact the College Houses at phone: 512-476-5678, 800-880-2676, fax: 512-476-1743, e-mail: info@college houses.org, website: www.collegehouses.org/Default.htm#About Coops. The Inter-Cooperative Council runs eight house near the campus (Arrakis, Avalon, French House, Helios, House of Commons, New Guild, Royal House, Seneca Falls.) Contact the ICC at phone: 512- 476-1957, fax: 512-476-4789, email: iccmail@uts.cc.utexas.edu, website: www.utexas.edu/students/icc/intro.html.

Chapter 5

Enriching Your Undergraduate Education

5.1 Motivation

Do you know why you came to UT? Do you know why you picked astronomy or physics for your major? If you cannot answer these questions, you might be in trouble. Maybe you will be fine during your freshman year. Just go to classes, experience college life, do homework, and have fun. But I'm telling you, sometime in your college life you will ask yourself what you are doing this for. Suddenly, you feel lost, like the people who followed Forrest Gump running all over the country until he suddenly decided to go home in the middle of a desert. They felt lost because they didn't have any purpose for running, any motivation for their actions, and no goal. Even those who had reason to follow Forrest at the beginning had forgotten their motivation after such a long time. I was the latter case.

I am an international student from Tokyo, Japan, who hated English classes in high school. That's why my English teacher was so surprised to learn that I was coming to United States to study. But I had reasons to come here: I wanted to study astronomy in the U.S. I considered myself, therefore, well motivated and focused then. At least it was enough for me to change my environment completely, including the language, though I now know that was partly because I didn't realize all the consequences of living in a foreign country. Anyway, the first thing I had to pass was English, which took me a whole year, and I had to take many non-science classes in the first two years such as religion, macroeconomics, international politics, and an English composition class while I was taking chemistry and the accompanying lab. My passion for studying astronomy started to erode as I struggled in the university's required courses, and I was tired and depressed going to classes to get more homework to do. This is when I asked myself what I was doing this for?

It is difficult to keep focusing on the big picture while trying to finish day-to-day homework, but the most important key to be successful in college is really to have a goal. Once you are focused, what you need to do follows naturally. It is very difficult to survive upper division physics classes such as quantum mechanics without motivation or a goal. So what do you need to do? First, if you don't have the answer to the question, find it! The sooner you have the answer, the better it is. For those of you who have an answer or who dusted off the answer you had, there are two choices: a plain diploma or an enriched diploma. Your choice depends on your answer. If your goal is satisfied by getting an astronomy or physics degree laid out by university, class work will be sufficient. If your goal is more than simply doing course work, UT is a wonderful place to be. There are many ways you can enrich your undergraduate education by getting involved in the astronomy or physics department as well as outside of UT.

Both departments offer seminars and colloquia with different topics every day. The high gravity journal club, stellar seminar, and interstellar medium (ISM) seminar are among those offered by astronomy department. You can interact with the department more actively by getting a research position. This will give you very good experience actually "doing" astronomy. The UT astronomy department has wide range of astronomers working on areas from planetary astronomy to theoretical cosmology (see Appendix A for a list of researchers and their field of interest). If you are more ambitious, try to land an internship. It provides more experience doing astronomy and interacting with astronomers outside of UT. Finally, graduate school could be your goal! If your ultimate goal is to be a professional astronomer, graduate school is the nearest goal you need to achieve. This chapter will go into further detail on these four activities you can do to enrich your undergraduate education.

If you are an aspiring astronomer, these outside activities are REQUIRED in order to get into graduate school, and I suggest that you get involved as soon as possible. I remember that when I transferred to UT in the middle of my sophomore year, I regretted so badly that I didn't come to UT earlier, because I missed so many opportunities at UT. Being a research-orientated university, UT offers many research positions for undergraduate students. These experiences should be of interest to you, and also necessary when you apply for graduate school.

5.2 Colloquia and Seminars

Both the astronomy and physics departments offer colloquia and seminars everyday. For example, the astronomy department holds stellar astronomy seminars every Wednesday at noon, in which most people bring their lunch. There is variety of seminar topics, and in each seminar speakers present their research or discuss workshops they have recently attended. Colloquia are somewhat more formal than seminars. Speakers in colloquia are invited from different universities or other departments at UT. The schedule for weekly seminars is on the astronomy department web page, on the 15th floor near the large classroom, and often in the glass case on the 4th floor near the astronomy posters. If there are talks that interest you, go check them out. I want to remind you that this is one of the advantages of being in the UT astronomy department, one of the biggest astronomy departments in the United States. The department has many astronomers from different fields of astronomy, and some are highly respected in their fields. If you are at a small institution, this variety is not available.

Attending colloquia and seminars helps you in several ways. First of all, they are very interesting and exciting talks. You might just be curious to hear what has to be said about a certain topic. The talks are aimed at graduate students and professional astronomers, so don't worry if you don t understand most of the talk. It is a safe bet that half of those in the room don't fully understand the talk. However, you want to have a basic astronomical background before you attend these talks so as not get stuck on basic notation and stuff like that. After a few talks on the same topic, you will begin to notice that you have some background knowledge about the topic just by attending these seminars. If you want to understand more, I suggest you to take notes. It helps you to concentrate on the talk and organize information you do and don t know. If you hear the same word you don t understand more than twice, look it up in a book or on the web. In this way, you are building background knowledge on the topic.

Second, attending different types of seminars helps you to decide which field of astronomy you are most interested in. Yes, many fields of astronomy are very interesting, but eventually you need to pick which field you want to work in. You need to make a first choice when you apply for graduate school. Since no single school has every field of astronomy, you want to know what you like before you decide on which schools to apply to so that you don t end up wanting to study a field that your graduate school doesn t offer. One of the talks might even inspire you to research on the subject for your life!

Also, this is a place to get to know UT astronomers. Unless you are taking AST 104, in which UT astronomers talk about their current research, you don t have many chances outside of seminars to hear about what they do. If you are seeking a research position, this is one place to get to know what research is going on. In addition, after a while, people in the seminar will be familiar with your face or even get to know you.

Unfortunately not many undergraduate students attend colloquia and seminars. So the first thing you notice when you step into the room is that you are the only undergraduate student there. Don t be scared to take a seat among the astronomers. Everyone is invited to the colloquia and seminars. Just sit back, be respectable, and enjoy!

5.3 Getting Into a Research Program

First, the general situation: If you haven't realized it by now, you are completely on your own. There is no official process at all which helps you become associated with and supported by a faculty member. You simply have to start knocking on doors to learn what people are doing and if they have room for new students. You might want to bring along a resume/curriculum vitae. If you are interested in someone in particular, find out the names of post-docs, grad students, and undergrads who already work for her or him. Then go to them to gather details on the work being done and the atmosphere in which it is done. Frankly, there are a few professors who are lousy to work with. Some are too busy to work with you, others have few resources and no means of supporting their students. Choosing an advisor is an important decision and you should be careful and get many second opinions.

I suggest that you begin considering your options for an advisor immediately. In my opinion, an optimal situation is one in which you begin approaching professors during your second semester here and begin working (on at least a trial basis) with someone over your first summer.

On rare occasions, you might even find summer support this way. Even if you're not certain what it is that you want to do, talk to the graduate students and professors in the fields you are at least interested in. Getting into a group can involve some delicate maneuvering. In some cases you should plan to offer some time, as much as a semester or longer, volunteering. As one professor put it, "If you become indispensable, we'll keep you around."

5.4 Internships

What is an internship?

An internship is a way to experience what professional astronomers do while you are an undergraduate student. You will learn new skills, learn more astronomy, meet the other students who have the same interest with you, meet more astronomers, and on the top of it all, get paid for it. Most astronomy internships are sponsored by National Science Foundation (NSF) under a program called Research Experiences for Undergraduates (REU). International students have less opportunity because those internships that are funded by NSF only accept U.S. citizens or permanent residents. However, if you look hard, there are some programs not founded by NSF.

So why do people bother to go through tons of paper work and troubles to get internships? Here are the reasons:

- Grad school - If you haven't done any research work during semester, this is the chance to get research experience. Also for those of RLM residents, this will look very very good on your transcript. Assuming you do well on your project, this is a potential source of a letter of recommendation. After all, the fact that many graduate students have internship experience seems to give us a compelling reason to get internships.

- New Skills - You will learn many new skills dealing with real data. You learn how to reduce and analyze data as well as how to approach the problems you have. Most programs require you to give a talk at the end of the summer, which is a good practice for you.

- Do you really want to do astronomy? - This one summer is a way to see if you like to do astronomy for rest of your life. You sit down in front of computer eight plus hours a day, reducing and analyzing data, learning theories, and applying theories.

- Meet new people - It is nice to see fellow undergraduate students who have the same interest with you. Many of intern students are planning to go to graduate school. You might exchange knowledge of astronomy with them, and you know it's simply fun to hang out. New people you see there are not only students but also astronomers in various field. Interacting with many astronomers, you learn about their fields, about being astronomers, and about themselves.

Hopefully, they will learn about you, too. (And hopefully, some of them can write you letter of recommendation!)

- Money - Most internships pay between $2500 and $4000 for the summer. Depending on the program, housing is provided, and travel expense is reimbursed, fully or partially. Sometimes the salary is arranged in the form of scholarship, which doesn't require you to pay taxes for it. You might not earn so much, but you don't loose any.

- Change of scenery - You got the best excuse to get out from RLM!

If you think you are not ready for it because you haven't done any astronomy before, you are wrong! It seems more experience with reducing data you have, the better a chance of getting internships you have. This is not always true. One of the purpose of the programs is to give undergraduate students a research experience and for students to learn. Most likely, they will give you a project that is new to you so that you can learn new skills. If you don't know how to use IRAF, then they will give you a project, which require IRAF to do. In fact, I know few of intern students who haven't taken any astronomy classes nor done any astronomy researches, but they learned how to do and produced results at the end of the summer. Although it is a job, and you have responsibility to finish your work, this is your learning opportunity, and you are supposed to do so. You shouldn't be embarrassed of not knowing but should be embarrassed if you don't try to learn things you don't know.

How To Do It

The first step is to find out what internships are available and to determine which you want to do. One place to look is the undergraduate bulletin board on 15th floor. Postings start appearing as early as November. Another place is web search; use the combination of keywords "REU" and "astronomy." In general, you can find better description of programs and about the institutions on their web page. If you find programs you are interested in on the bulletin board, visit their web page to learn more about the program. Notice that most of the programs involves in astronomy, but some are more engineering or programming oriented, or in a field of atmospheric sciences. Learning what programs are about is, therefore, very important. Also pay attention to which astronomy is available for you to do. For instance, if you want to do theoretical astronomy, you don't want to spend your whole summer at a place which only offers observational astronomy. In addition, knowing programs helps you to write better essay for the application.

Once you decide which programs you are interested in, ask them for more detailed description and application forms. It is ideal to get all application forms before Christmas. To early? Never too early, you know that well. The due dates for the applications are typically mid February, and you want to have them sent at least a week before due. I feel a little guilty talking about dead line since I sent my application few minutes before dead time! It was possible only because my application was electrical. In most cases, you deal with the post office, and you should expect at least 3~4 days to be delivered. So, let me make a humble suggestion; be prompt. Most applications require the following.

- Basics - Basic information about you: your name, mailing address, e-mail address, and your academic background.

- Transcripts - Many applications require you to send transcripts from all educational institutions you attended. UT transcript costs $5 each. If you have multiple programs to apply for, your life will be much easier with a list of programs with the addresses, phone number, and deadline. Use the list at the UT transcript office in the Main Building. When you tell them you need to send transcripts, they ask you to write down all the addresses, which is annoying. If you take the list, you just smile, give them the list, pay the cost, and leave! **Warning**: If you have any kind of bar, you cannot have UT transcripts sent!

- Letters of recommendation - This is important component of application next to the essay. You will need 2 or 3 of them in average. A professor, a lab instructor, or your academic advisor should write the letters of recommendation; someone who knows you well, who can evaluate your ability and experience, and most of all, who can write good things about you.
  Ask as early as possible: before Christmas is not too soon. Give each person a copy of the list you made up and emphasize on the deadline. Hand them a copy of your resume and all the information about the internships you are applying for. And be sure to ask them if they need stamped and addressed envelopes. Basically, you want to give them enough time and information. Few weeks before the deadline, ask them if the recommendations were already sent out. In general, they are most punctual and will get them out with plenty of time to spare. But they are very busy, and sometimes, they do forget things! So remind them that deadline is coming up, and come back to them few days later to ask again. Finally, write a thank-you note to everyone who wrote recommendations for you. This is important - they did you a big favor!

- Essay or letter - This is the most important part of your application. You might be given the format to use. If so, then follow the format closely. If the format is not specified, just make your essays look nice and be concise, or ask them what format they prefer. If possible, it's a good idea to put your name, email, and mailing address at the top of the page unless you are writing a letter. This prevents your paper not mixed up with other applicant s. If you are writing a letter, put the proper headings on the letter as well as a signature.
  What do you say in one of these essays? That depends on the program and on your own experience. Some program indicates what they want to know from your essay and some don't. Basically your essay can include your scientific experience, educational background, and career goals. If there is an issue that you feel needs to be addressed, and

there is no other place to address it, do it in the essay. For instance, I mentioned that it is difficult for international student to get an internship, and that this position would help my further academic career. But keep in mind that they are interested in your academic background and career goals. Often times, they are also interested in knowing which field of astronomy you are interested in. Most programs will match you with an astronomer, and knowing your interest will help them making good match. In other words, if you specifies a field of astronomy which is not being studied at the institution, they might turn you down regardless your good background. So, knowing what is being studied at the institution and keeping that in mind while you write an essay is very important. The application information usually tells you about faculty and scientist research interests. If it doesn't, look up the institution on the web.

If you still don't know which field of astronomy you are interested in, express that your interests are broad, and that you are willing to work on any astronomy. This might give you more chance of getting a project. Since so many fields are so attractive to me, I mentioned in my essay that I am willing to try any filed of astronomy. Meantime I mentioned that I was especially interested in the stage of mass loss before planetary nebulae phase, supernovae, and compact objects like neutron stars and black holes. Luckily, my project was exactly what I specified that I was interested in, namely Luminous Blue Variable (LBV)!

- Resume or curriculum vitae - For the purpose of REU applications, it is generally okay to assume that a resume is a curriculum vitae, or vice-versa. (It is not necessarily okay for other purposes.) Try to keep it to one page.

Before you send those applications, make sure that you have everything for the each program, and that you don't have an essay you wrote for CTIO in an envelope for STScI. Double check everything, send them a week before the deadline, and wait for job offers. If you want to make sure that they get your applications, call them or send them e-mail to ask. But they inform you that they received your application. Normally, the announcement will be made in March in forms of phone calls, letters, or e-mails. If you don't hear anything from them few days after the date indicated for the announcement, check with them if anything is wrong. The announcement letter might be delayed, or they might not have decided yet. If you do not get the position, don't berate yourself. You can find a research opportunity at UT or clear up some classes in summer school. But save all essays and resumes so you can try again next year!

If you get offers, congratulations! You have few weeks to decide weather you accept the offer or which program you accept. If you get an offer from the program you really want, go for it. If you got offers from programs, which are not the one you really want, and if you haven't heard from the one you really want, call the one first to check if you are accepted. You don't want to rush accepting a position and lose a chance to work for the one you really want. In a case you didn t get offer from the one you really want but get one from another program, take the offer you get unless you change you mind about the program. It might help you make a decision if you go talk to people in the department about the positions you are offered. Professors might know well about the institutions and programs and might be able to tell you reputations. If you know someone who has done any internships or at the same program you ve been offered, they are the ones you need to talk to. They can tell you details of their experiences, good and bad. In general, take any offer you get. This is a very good chance to learn astronomy, to know what your goal is, and to earn experience as an astronomer.

Everyone that I met in the program enjoyed their research experiences, and it was an eye opening experience for some of them. Each one of them says it was a great summer. The institution you work for likes to have summer students, and your advisor is also very happy to have you there. They all work hard to make it a good experience for you and the other students. Also you have fun time outside of work in another city with astronomy students and others from different places. This is a way to have an enriched summer.

Getting Ready

After you notify a program your acceptance, your institution will give you information you need for travel, housing, meal plan, and so on. You can either drive there or fly there. Flying is easier way: most programs reimburse you for the flying tickets, and they arrange flight for you. So you just pack lightly, get tickets, and fly there. Despite of pain for driving for few days to get there, having a car with you is probably a great help to go around the city. Also you have advantage of bringing more stuff. In case of driving, the institution reimburse you 25 cents a mile or as much as your flight cost or whichever less expensive.

If your program provides housing and/or meal plan, it s great, and you have no choice. But sometimes you have to find a place for yourself. A nice thing my institution did was to send e-mail list of all participants of the program so that we could find places for each other and exchange information about the city and housing situation. Look for school newspapers that correspond to The Daily Texan. There are lists of summer sublets as well as those seeking roommates. Also talk to people you know. They might know someone who is in the city you are going and is willing to help you with housing. Information from locals is precious; they know exactly which is a good area and which is a not so good area to stay. When you find places you are interested in, call them to ask questions. Does the place have A/C? How are the bills handled? Microwave? Dish washer? You get the idea. Since you are not there to look the place, get as much information about the place and make sure if it is what you want so that you don t get any surprise when you get there.

What can you do in Austin to get ready for the summer project? After you accepted the offer, you will be in contact with your advisor who let you know what your project will be, sometimes with suggested papers and books to read. Most likely your project will be new to you in different ways. It could be new subject, new type of data, new software to use for data reduction, etc. Although the summer project includes learning period of time for you, it is a good idea to get to know those new things as much. Search in astronomical journals such as Astrophysical Journal (ApJ) for papers written by your advisors, and especially for papers about your object(s). Since it is new to you, you might not understand the paper at all. Don t worry. What you need is to learn how to learn new things, which is important as you go further along. In this case, you can ask questions to your advisor, or go to the library to look for textbooks about your subject to get general background and then go back to the papers. This is a part of research and of what you will be doing in the summer. And by the end of summer, you might be writing a paper about your research!

I personally learned so much from this one summer in many aspects. Of course I gained an experience which I can write in graduate school applications. But this is more than that. I met lots of astronomers including my advisor and fellow astronomy students who are enthusiastic about their projects. I studied new subject that coincidentally I was interested in learning for long time. Also I had dealt with ground based spectroscopic data, and I reduced new type of data this summer, namely HST imaging data. And I learned astronomer attitude to data and to results. I can write all I gained from this experience, but you don t gain them until YOU experience it yourself. I hope I showed you how wonderful the internship experience is, and when you have a chance to do it, don t miss it!

5.5 Graduate School

This is a section for those of you who are willing to sacrifice your time, money, and life to pursue further career in astronomy. It is a long way to become astronomer; you will spend six years in graduate school to get Masters and Ph.D. degrees, and normally you will get two or three post doctoral positions, each of which lasts two years in average. So you expect at least ten years till you can get astronomer job from universities or other institutions. I don t want to discourage you, but you need to realize what you are getting into, because going to graduate school is a big commitment.

As soon as you know that you want to go to a graduate school, start to prepare for it. When you apply for graduate schools, you need a good GPA, good GRE scores, and good letters of recommendation. Needless to say, you need better of those three things to get into better graduate schools. It is your advantage to start planning to go to a graduate school because good GPA or letters of recommendation cannot be earn during one semester. It is difficult to say what are the minimum values of GPA and GRE in order to go to a graduate school. Some schools require 3.5 or higher GPA, and some require only 2.5 GPA. The same is true for the GRE. You ll have better idea when you look for schools you are interested in. But probably the most important thing is to have good letters of recommendation to get into a graduate school. If the GPA is a measurement of how good student you are, the letters of recommendation are measurements of how good researcher you are. Unlike undergraduate studies where your major work is classes, you spend half of your time for classes and the other half for researches for the first two years of graduate school, and after getting Masters degree, you only have research. That s why letters of recommendation are important.

The most common way of getting a letter of recommendation is to work with a professor doing research. There are professors and researchers in the astronomy and physics departments who are willing to have undergraduate students in their research groups. Sometimes they can even pay you for the undergraduate research assistant position. I think the best letter of recommendation comes from a person who knows you very well and who has seen your hard work. For professors and researchers who write those letters, recommending a person is their responsibility and reputation. If a professor writes false excellent letter of recommendation for a lazy ass student, the school who accepted the student for the excellent letter won t trust the professor anymore. So professors are very careful about letters of recommendation. Working on researches with them is a good way to let them know you well. If they have seen your good work and are confident that you are a good researcher, then they will write you a real excellent letter of recommendation. Also you get a good byproduct; that is the experience of doing research, which you will be doing in the graduate school.

Another source of letters of recommendation is summer internships. This is highly desirable because it gives you not only a good letter of recommendation but also a good look at how astronomy is done outside of UT. There are more detail discussion on research job and internships earlier in this chapter.

The main point of all this, projects and internships, is to gain experience as a researcher and to build up your skills. If you know how to make observations, reduce data, program, or build instruments, your chances of getting into graduate school are much better. Of course, good grades and high GRE scores are also important, but it s these skills that will make you stand out from the other applicants.

It will be tough getting into a graduate school. You ll have to work very hard through out your undergraduate years to show that you are a good student and a good scientist. But through researches and internships, you learn skills that will make you stand out from other applicants. This is one of times when you have to manifest your enthusiasm of studying astronomy into specific forms, in this case, GPA, GRE, and letters of recommendation. Good luck!

Appendix A

Faculty and Research Scientists

This section is a basic overview, person by person, of the faculty and research scientists and their research interests. This list will look very much like the list on the walls of the 15th floor hallways, but you won't have to stand in front of them for the information (unless you want to look at the photographs.)

A.1 Faculty Members

Frank Bash Dr. Bash is the director of McDonald Observatory, and has been since 1989. In 1985 he was named the Frank N. Edmonds Jr. Regents Professor in Astronomy. His research interests are the large-scale structure of spiral galaxies and star formation on the large scale.

Harriet L. Dinerstein Dr. Dinerstein is an Associate Professor. She received the Annie Jump Cannon Award in 1984 and the Newton Lacy Pierce Prize in 1989. Her research interests are studies of chemical abundances and physical conditions in HII regions and planetary nebulae through optical and infrared spectroscopy; infrared studies of dust emission in regions of star formation, planetary nebulae, and supernova remnants.

James N. Douglas Dr. Douglas is a Professor. He was the director of the now-defunct Radio Astronomy Observatory at Texas. His research interests include observational radio astronomy, extra-galactic radio sources, and long wavelength sporadic radio storms from Jupiter.

David S. Evans Dr. Evans is the Jack S. Josey Centennial Professor Emeritus in Astronomy. His research interests are observational stellar astronomy, lunar occultations, flare stars and other variables, and the history of astronomy.

Neal J. Evans II Dr. Neal Evans is a Professor. He is also the Edward Randall, Jr. Centennial Professor. His research interests are in molecular clouds, star formation, millimeter, submillimeter and infrared astronomy.

Paul Harvey Dr. Harvey is a Professor. His research interests include infrared studies of the interstellar medium, with particular interest in regions of star formation.

Mary Kay Hemenway Dr. Hemenway is a Senior Lecturer. Her research interests are astronomy education, teaching courses and offering workshops for elementary school, secondary school, and college teachers.

Daniel Jaffe Dr. Jaffe is a Professor. His research interests include submillimeter and infrared observations of star formation regions, physics of dense interstellar medium, submillimeter and infrared instrumentation.

William H. Jefferys Dr. Jefferys is a Professor and a former Chairman of the Astronomy Department and is the Harlan J. Smith Centennial Professor in Astronomy. He is the head of the Hubble Space Telescope Astrometry Team at Texas. Dr. Jefferys was recently awarded the Lifetime Research Award from NASA. His research interests are astrometry with the Space Telescope, dynamical astronomy and stability of dynamical systems.

John Lacy Dr. Lacy is a Professor. His research interests infrared spectroscopy, infrared studies of interstellar molecules, studies of ionized gas in the Galactic Center, and the development of high-resolution infrared spectrographs. Dr. Lacy has worked with many undergraduate students on a variety of research topics.

David Lambert Dr. Lambert holds the Isabel McCutcheon Harte Centennial Chair in Astronomy. He was awarded the Dannie Eleineman Prize in 1987. His research interests include stellar atmospheres, chemical compositions of stars, chemical evolution of the universe.

R. Edward Nather Dr. Nather is the Rex G. Baker Jr. and McDonald Observatory Centennial Professor in Astronomy. He created what is now known as High-Speed Photometry. His research interests are the exploration of the stellar graveyard, interacting binary collapsed stars, white dwarfs, neutron stars, and black holes, using computer-aided electronic techniques as the principle tools. His concept of the Whole Earth Telescope (WET) has revolutionized the field of astroseismology. He is a former Director of WET and has been named Director Emeritus.

R. Robert Robbins Dr. Robbins is an Associate Professor. He is also the Undergraduate Advisor. His research interests are interstellar matter; gaseous nebulae and novae; chemical abundances and radiative transfer in moving, inhomogeneous, optically thick gases; the structure of interstellar clouds; and astronomy education. As well, Dr. Robbins does research on archaeoastronomy, the astronomy of ancient peoples. Dr. Robbins also teaches an upper-division course on archaeoastronomy.

Edward L. Robinson Dr. Robinson is the William B. Blakemore II Regents Professor in Astronomy. He was an Alfred P. Sloan Research Fellow from 1977-81. His research interests include observational studies of white dwarfs, neutron stars, black holes, cataclysmic variables, low-mass x-ray binaries, x-ray transients and pulsating white dwarfs.

John Scalo Dr. Scalo is a Professor. He is also a Jack S. Josey Centennial Professor in Astronomy. He was an Alfred P. Sloan Research Fellow from 1977-81. His research interests are star formation, interstellar cloud structure, turbulence, galaxy evolution, and complex systems.

Paul R. Shapiro Dr. Shapiro is a Professor. He was an Alfred P. Sloan Research Fellow from 1984-88. His research interests are theoretical astrophysics, including cosmology and galaxy formation, theory of the interstellar medium, the intergalactic medium, and astrophysical hydrodynamics.

Gregory Shields Dr. Shields is the Jane and Roland Blumberg Centennial Professor in Astronomy and was an Alfred P. Sloan Research Fellow from 1979-83. His research interests are in active galactic nuclei, galactic chemical abundances and ionized nebulae.

Chris Sneden Dr. Sneden is a Professor. He formally introduced the idea of the Spectroscopic Survey Telescope (SST) - now called the Hobby-Eberly Telescope (HET) - to the University of Texas from Penn State University. His research interests are the chemical compositions of stars, with regard to stellar evolution and galactic nucleosynthesis.

Stephen Weinberg Dr. Weinberg is a Professor and Nobel laureate. His research interests include theoretical astrophysics and cosmology.

J. Craig Wheeler Dr. Wheeler is the Samuel T. and Fern Yanagisawa Regents Professor in Astronomy. His research interests are in the theoretical studies of stellar evolution, supernovae and accretion disks. As one of the Department's resident writers, he is author of *The Krone Experiment* and several short stories. He is also the graduate advisor.

Derek Wills Dr. Derek Wills is a Professor. He is also ASA's Faculty Sponsor/Advisor. His research interest is individual and statistical properties of quasi-stellar objects.

Donald E. Winget Dr. Winget is a Professor. He was awarded the Newton Lacy Pierce Prize in 1986, the Presidential Young investigator's Award from 1986-91, the Robert J. Trumpler Award in 1983, and was an Alfred P. Sloan Research Fellow from 198589. His research interests include late stages of stellar evolution and stellar pulsations. He is also involved in the Whole Earth Telescope.

A.2 Research scientists

Edwin S. Barker Dr. Barker's research interests are asteroids, comets and planetary atmospheres and surfaces, and extra-solar planets

Thomas G. Barnes, III Dr. Barnes is a Senior Research Scientist and is also the Associate Director of McDonald Observatory. His research interests are observational aspects of variable stars, and photometry and radial velocity studies of classical Cepheids, RR Lyrae variables and late-type variables.

G. Fritz Benedict Dr. Benedict's research interests include space astronomy, astrometry, image processing and surface photometry of galaxies.

Anita L. Cochran Dr. Anita Cochran is a Research Scientist, and occasionally teaches a Solar Systems class, AST 364. Her research interests are Solar System astronomy including the chemical composition of comets and surface composition of asteroids.

William D. Cochran Dr. William Cochran's research interests are planetary atmospheres, comets, asteroids, variable stars, high-precision measurements of stellar radial velocity variations, and the search for extra-solar planetary systems.

Robert Duncan Dr. Duncan's research topics include neutron stars, gamma ray bursters, soft gamma repeaters, dynamos and astrophysical magnetic fields, quasar absorption lines and the universe at moderate redshift, the Lyman-Alpha forest, and theoretical astrophysics.

Robert Harkness Dr. Harkness' research interests include supernovae, radiative transfer and radiation hydrodynamics.

Artie Hatzes Dr. Hatzes' research covers various aspects of stellar astronomy, including active late-type stars, Doppler imaging, precise stellar radial velocities, planet searches, low amplitude stellar variability, and astroseismology.

Gary Hill Dr. Hill is the Project Scientist for the Hobby-Eberly Telescope Low-Resolution Spectrograph and the Prime Focus Instrument Package. His research interests include observational cosmology, radio galaxies and quasars, astronomical instrumentation.

Peter H flich Dr. H flich s interests are supernovae, explosion mechanisms, cosmology, radiation transfer, radiation hydrodynamics, non-LTE, nucleosynthesis, and molecule formation.

Daniel Lester Dr. Lester's research interests are infrared emission lines and abundances in HII regions, infrared studies of star formation and starburst galaxies.

Hugo Martel Dr. Martel s research interests are cosmology, formation of galaxies, large-scale structure, gravitational lensing, star formation and computational astrophysics.

Frank Ray Dr. Ray works on instrument development and design, structural analysis, large mirror and large telescope technology, and studies design research methods.

Peter J. Shelus Dr. Shelus is the director of McDonald Laser Ranging Observations. His research interests include laser ranging, Earth and lunar dynamics, astrometry.

Verne Smith Dr. Smith's research interests are spectroscopy, stellar atmospheres and nucleosynthesis.

Webster Smogpule Dr. Smogpule's primary research is in applied exomycology. He is also involved in instrumentation, including, but by no means limited to, the rail-gun for the Rapid Transatmospheric Transport Of Small animalS (RaTTOSS) project.

Jocelyn Tomkin Dr. Tomkin s research interests are high-resolution stellar spectroscopy in the areas of stellar composition and eclipsing binaries.

Laurence Trafton Dr. Trafton is a Senior Research Scientist. His research interests are planetary atmospheres, evolution of the Solar System and volatile transport.

Robert G. Tull Dr. Tull's research interest is astronomical instrumentation.

Beverly J. Wills Dr. Wills research interests are in active galactic nuclei in x-ray to radio wavelengths.

Appendix B

Computers

Introduction

Computers are pervasive in the sciences. In the field of astronomy, they are absolutely essential tools, both for the student as well as the researcher. Given the prodigious growth of computer usage in the last decade, chances are that you already have quite a bit of experience working with word processors, e-mail, and other related applications. As an astronomy student, you will learn to do much more with these machines. Astronomers use computers for just about everything: operating equipment, analyzing data, running simulations, acquiring information, communicating with colleagues, giving presentations, and much more.

The sciences are where the Microsoft monopoly breaks down. Most of the science conducted by astronomers cannot be done with run-of-the-mill operating systems and applications. The computer tools used in astronomy may not be as user-friendly or aesthetically pleasing as their more widely marketed general-use cousins, but they are vastly more powerful. In the coming years, you will be exposed to such tools as IRAF, AIPS, UNIX, IDL, and many others. Learning how to use all of these might seem an imposing task, but doing so will make your life as a student and an astronomer much more livable than otherwise.

Services

During your stay at UT, you will have access to some of the best, and granted some of the worst computers available. You will also have free access to the Internet. The Internet had its roots in the scientific community as a communications network for collaborating researchers. Despite its many other uses today, the Internet is still used to a great extent in its original capacity. Many books on the Internet are available at most bookstores, but generally, the best way to familiarize yourself with it is to ask someone who is well-versed in its usage. Following is a brief outline of the computing services available to you.

E-Mail One of the most widely used computer services is electronic mail, or e-mail. From most of the computers on campus, you can send e-mail to anyone with an e-mail address, which is quite a lot of people. Communications of this kind are invaluable in keeping in touch with collaborators and colleagues. Even locally, e-mail often proves to be the best way to keep in touch. Since astronomers often keep strange hours, phone calls don't always work, and trying to physically find the person can be nearly impossible. Sending an e-mail message almost always gets a response, however.

FTP File Transfer Protocol is one of the way files are sent across the Internet. Anonymous FTP sites are set up around the world. Anyone can connect to and request files from these sites. A typical FTP session may involve downloading a program from Japan, extra fonts from New Mexico, and the latest ephemeris data from Australia. Literally millions of files are freely available from all over the world.

Information Services The many and varied information services once scattered all about are now almost universally available via the World Wide Web. Any single description of the web would be sorely inadequate. The only way to truly learn about the web is to get on and explore it for yourself. By far the most popular web browser is the Netscape Navigator. It can be run from practically any graphical terminal or workstation.

Computing Power This is where the distinction is truly made between the average marketed computer and the computing resources available to you at UT. Some of the computers you will use are substantially more powerful than most PCs or Macs. The university even runs a visualization lab with a Cray supercomputer. If your astronomical interests ever lean towards simulation, you will want as much computing power as possible.

Etiquette

As a relatively open system, the Internet largely survives on trust. No one monitors what you say in unmediated postings, but that is on the understanding that no one posts garbage. No one charges for FTP sessions, but don't take that as an open invitation to download gigabytes worth of files during heavy network hours. The best rule of thumb to follow is not to be a jerk. Here are some quick tips:

- Don't leave yourself logged in. Computer terminals are in short supply, and since it's considered rude to log someone else off, you end up making it impossible for someone else to work. You also stand the chance of someone using services on your account, which you will have to pay for.

- Don't log other people out. Occasionally someone will leave themselves logged in because something is running on the computer. Logging someone off can have catastrophic consequences. It's usually less painful to spend the time finding another terminal than it is to bear the wrath of the person you just logged out.

- Don't mess with other people's files. Even if they were silly enough to leave their write permissions on, that's no reason to go tromping through their files. It's the job of the system administrator to inform the person of their error.

- Don't tie up the printers for long periods of time. Most of the printers on campus are used by graduate students, professors, and other undergraduates. Printing large jobs is an easy way to offend a lot of people.

- Don't break into other people's accounts. Not only is this unconscionably rude, but it is also illegal. You stand the chance of getting kicked out of UT, fined, jailed, and having your transcript frozen. This is no joke.

- Don't *ever* turn off a computer terminal. Many of the computers on campus run either UNIX or VMS. These operating systems need to shut down in an organized fashion or risk losing information. These operating systems are also multi-user and multi-tasking, so turning off a computer may shut down several users, not just you. The power switch is always the last resort and is reserved for the system administrator.

Security

Computer security is an unfortunate issue that we are forced to deal with. Luckily, a great deal of security measures have already been taken by the people running the computers. Your job as a user is not to be naive. Here are some things you can do to make life tough for would-be abusers of your account:

- Don't leave yourself logged in. Even if you're only going to the restroom, log of out or lock your terminal. Much damage can be done in the two minutes or so that you will be away.

- Use different passwords for different computers. Make life hard for someone attempting to guess your password. Even if they do guess one, your other accounts will be safe.

- Pick a good password. Make the time required to guess your password as long as possible. Here are some tips:

Do not use your login name in any form (capitalized, reversed, etc.).
Do not use your first or last name.
Do not use the name of anyone in your immediate family
Do not use any information about you which is easily available (Social Security number, license plate number, birthdate, etc.)
Do not use a password which is all one character or a blank password
Do not use any word contained in a dictionary
Do not use a password shorter than six characters

Do try to mix upper and lower cases
Do try to include letters, numbers, and punctuation marks
Do choose a password you can easily remember. If you have to write it down, others can read it and abuse it.
Do choose a password that is easy to type without having to look at your keyboard. If it is typed slowly, others can watch you typing it.

Here are some good schemes for choosing passwords:

Choose a sentence or phrase you can easily remember, and use the first letter of each word and all punctuation. For example, "Intuitively obvious to the most casual observer." would become "Iottmco." This is easy to remember, but difficult to guess.
Choose two short, unrelated words and a punctuation mark to join them. For example, "owl;clap", "No#bridge", or "All&read". Often, the more ridiculous they are, the easier they are to remember while still remaining difficult to guess.
Choose four consonants and four vowels and alternate between them to form syllables. This makes nonsense words which are still easy to remember. For example, "kobanule", "sanofura", or "loticure".

When choosing a password put yourself in someone else's position and ask yourself how easy it would be to guess the password you have chosen.

- Look for obvious strangeness. If you always notice someone watching you when you type your password, you're probably not being paranoid if you suspect them of foul play. Don't call 911, though. Simply discourage them.

If you really do think that someone is attempting to break into your account, don't pursue them yourself. Contact the system administrator. They're much better trained, they have tools to gather evidence in case of prosecution, and it's their job.

How to Get an Account

As an astronomy student, you should have an account on the departmental computers. Disk space is limited, however, and there are other computers on campus you can get an account on.

The Computation Center runs a number of Sun Sparcstations as well as the PC and Mac facility at the Flawn Academic Center. Printing, dialup, and SLIP/PPP services are also available at a small charge.

Obtaining an individually funded Computation Center account is a fairly straightforward procedure. Take a student ID to the Computation Center and fill out an application for an IF account. Check the options you want on the application. You will receive an IF user name (usually something which looks like IFZA213) and a password. Keep the slip in a very safe place. When you get the chance, change the password!

Appendix C

Recreation in the Austin Area

C.1 Recreational Activities at the University

Gregory Gym Gregory Gym is located on the southeast corner of Speedway and 21st Street. The building is quite old but was recently renovated. Facilities include a weight room, treadmills, stationary bicycles, indoor rock climbing, swimming pools, racquetball courts, basketball/volleyball courts, and a lounge. The building also houses UT Outdoor Adventures, which offers rentals of camping equipment.

Recreational Sports Center The renovations at Gregory Gym have made it the preferred place to work out. Therefore, the Rec. Center is considerably less crowded. The facilities here are essentially the same as Gregory minus the rock climbing and lounge. The Rec. Center is immediately south of the stadium on the northeast corner of San Jacinto and E. 20th Street.

Clark Field Clark Field is located between the Jester Dormitory Complex and San Jacinto. A jogging path runs along the perimeter of the field. At the north end of the field are outdoor basketball courts. The field itself is, well, a field.

Anna Hiss Gymnasium Anna Hiss is located on the southwest corner of Speedway and 26th/Dean Keeton Street behind the Moffett Molecular Biology Building. The gym houses basketball courts and dance halls.

Whitaker Field These fields are more commonly referred to as the Intramural or IM Fields. Though a part of the University, the fields are actually located several blocks north of the campus at 51st and Guadalupe Streets. There are areas for soccer, baseball, football, etc.

C.2 Recreational Activities In and Around Austin

Shoal Creek Shoal Creek runs south to the Colorado River just west of central Austin. About four miles of its length is connected parkland. This portion of the creek parallels Lamar Boulevard just west of the UT campus. It has bicycle and jogging trails and a disc golf course. Also running along the creek is Pease Park, which has basketball and volleyball courts. Once a year in the springtime, there is an open-air party called Eeyore's Birthday Party. Words cannot describe it. You just have to see it for yourself.

Town Lake This lake is actually a part of the Colorado River that passes through downtown Austin. It is formed by the Longhorn Dam in southeast Austin. Much of the shore is parkland with many jogging and bicycle paths as well as the Auditorium Shores and Fiesta Gardens facilities, which host concerts, celebrations, etc. Boats can also be rented for trips out onto the water.

Congress Avenue Bridge The Congress Avenue Bridge over Town Lake is home to a colony of over a million Mexican free-tailed bats each summer. From March through October of each year, the bats can be seen emerging from underneath the bridge shortly before sunset for their nightly feeding, during which they consume between 10,000 and 30,000 pounds of insects. The best viewing usually occurs in the month of August.

Zilker Park Zilker Park is the chief municipal park in Austin. The 391-acre park is located three miles southwest of the UT campus just south of Town Lake. The park has soccer fields, volleyball courts, an outdoor theater, bicycle paths, a miniature train ride (really cool), and much open space for picnics, kite flying, frisbee games, or just walking around. Zilker Park also contains the Zilker Gardens, a Japanese botanical garden with miniature waterfalls, etc.

Barton Springs Barton Springs is located within Zilker Park. The springs are an outflow point of the Edwards Aquifer, a large underground reservoir of water bearing limestone southwest of Austin. Barton Springs flows at about 370 gallons per second into a large, man-made pool. It is a favorite Austin swimming area. Admission is currently $2.00 on weekdays and $2.50 on weekends. The water is 68 degrees year-round and not treated with chlorine.

Mount Bonnell Mount Bonnell is less of a mountain and more of a big hill. Still, the park at the top of the mountain offers a beautiful view of the Colorado River and the hills to the west of Austin. There is no entrance fee, but there is quite a set of stairs to climb to reach the actual overlook.

Barton Creek Greenbelt Barton Creek joins the Colorado River near Barton Springs. The greenbelt is a strip of parkland 1/8 to 1/2 mile wide along the creek extending nine miles upstream (south) from where the creek meets the river. The creek is usually dry but runs after rains or when the Edwards Aquifer is at maximum capacity. There are several swimming areas along the creek. Canoeing, kayaking, or tubing is also possible when there is enough water flowing. Hike and bike trails run the length of the greenbelt. These are very popular among off-road cyclists. Rock climbing and caving is also possible.

McKinney Falls State Park This is the closest state park to Austin. In fact, it's actually within the city limits. The falls are not high, but they provide several popular swimming holes, which are the chief attraction. The ruins of Thomas F. McKinney's (after whom the park was named) homestead are another attraction. Other activities include hiking, camping, fishing, mountain biking, and road biking. Entrance fees are $4.00 per person per day.

The Veloway The veloway is located in far south Austin just off Loop 1 south of Slaughter Lane. This facility is a 3.1-mile-long, 15-foot-wide, winding concrete track that is open only to rollerblades and bicycles. It is relatively flat, and surrounded by trees. This is a great place to rollerblade or ride without having to worry about traffic.

Wild Basin Wilderness Preserve Wild Basin is located just off Loop 360 north of R.M. 2244. The basin has numerous hiking trails that wind into the densely wooded hills and past creeks and small waterfalls. This is a nice place close to town for a light hike.

"The Rock" This is not actually a park, and it doesn't really have a name. Some refer to it as "The Cliff," "Acid Rock," or simply "The Rock." In any case, it is located on the north end of the Loop 360 bridge to the west of town. A large limestone formation rises up from the side of the highway. The top of it looks out over the bridge as well as the Colorado River. There is space to park at the base of the cliff, but be advised that parking here is actually not allowed, and police officers do occasionally come by to write tickets.

Emma Long Metropolitan Park Emma Long is located to the west of Loop 360 just off R.M. 2222 and covers 1,174 acres. The park is wooded and hilly. There are facilities for camping, boating, fishing, swimming, picnics, hiking, and off-road biking. The entrance fee is $5.00.

Lake Travis Lake Travis is located northwest of Austin and like Town Lake, is a portion of the Colorado River held back by a dam, in this case, the Mansfield Dam. The lake is quite large, with many marinas and swimming areas along its shore. This is a great place to spend a sunny Saturday.

Mansfield Dam Mansfield Dam holds back Lake Travis on the Colorado River. The structure was built in the 1930's under the Tennessee Valley Authority. On its south flank is a recreational area, which looks out onto the face of the dam. A pedestrian walkway across the top of the dam offers a great view of Lake Travis.

C.3 Recreational Activities in Central Texas

Note: Most state parks charge an entrance fee of one to four dollars per person per day. Campsites must be reserved ahead of time at (512) 389-8900.

Perdernales Falls State Park Perdernales Falls is about an hour drive west of Austin on Highway 290. The park covers 5211 acres. It has 19.8 miles of hiking/mountain bike trails through its wooded hills as well as primitive and developed campsites. There are also 14 miles of backpacking trails and 10 miles of equestrian trails. Be sure to look for the ruins of the stone house out at the southern end of the hiking trails. Other activities at the park include fishing, swimming, and tubing on the river. The main attraction of the park is the falls at the north end of the park. Hikers can venture out onto the rocks that form the falls when the water is at normal levels. A scenic overlook gives...a scenic overlook of the falls.

Enchanted Rock State Natural Area This is one of the most popular state parks in Texas. The main attraction is an immense, rounded, granite outcropping that rises several hundred feet above the surrounding terrain. The formation is actually only the tip of a vast, underground batholith, an upwelling of molten rock, which has cooled and solidified. The park is about two hours west of Austin, north of Fredericksburg. Despite the long drive, this is an excellent place to spend the day just poking around. A hiking trail leads visitors up to the summit of Enchanted Rock while others wind around its base. Armadillos abound. Rock climbing is allowed, but climbers must first check in at the headquarters. Campsites are available, but must be reserved well in advance due to the park's popularity. If you plan just to spend the day there, it is generally a good idea to call ahead of time to make sure the park is not at capacity. (915) 247-3903

Longhorn Cavern State Park Longhorn Cavern is located about an hour drive northwest of Austin off Highway 29 near Burnet adjacent to Inks Lake State Park. As the name implies, there is an extensive formation of caves here. Tours are given throughout the day, starting at 10 AM. The caverns are a comfy 64 degrees year-round. The park is only open for day use (no camping). Other facilities include a short hiking trail and picnic areas.

Inks Lake State Park Inks Lake is a great place to have a weekend campout without leaving the comforts of the city life behind. The park covers 1201 acres adjacent to Inks Lake. Along with the usual primitive campsites and hiking trails, the park also has showers and screened shelters. It also features a boat ramp as well as facilities for recreational vehicles. Fishing, swimming, and water skiing are allowed on the lake, and for those of us feeling somewhat adventurous, the park also has a golf course. Inks Lake is located off Highway 29 west of Burnet, about an hour drive northwest of Austin.

Colorado Bend State Park Colorado Bend is a little farther out there. The park covers 5328 acres and is located west of Lampasas, about two and a half hours northwest of Austin. Access to the park is via an extremely rough dirt road. I wouldn't recommend taking your Corvette out here for a weekend spin. Attractions at the park include the Gorman Falls and Gorman Cave. Due to the various hazards involved, access to Gorman Cave is through guided tours only. The park also offers mountain bike trails along with the usual primitive and developed campsites. Swimming and boating on the Colorado River are also possible.

Appendix D

Useful Terms

ACWL The Academic Center Workstation Lab, a Sun workstation facility in the basement of the UGL. The ACWL terminals are generally used to access the ccwf system, but have full Internet access, as well as laser and color printing.

AAS The American Astronomical Society. This is the professional society of the astronomy profession. Junior membership is open to undergraduates based on recommendations from full members who hold PhDs.

AAS Austin Astronomical Society. This AAS is the Austin community's amateur astronomy group. They are devoted to making astronomy accessible to the general public and host "star parties" (see below) on a monthly basis, if not more often.

AIPS Stands for Astronomy Image Processing System. This is one of the programs that is used to reduce astronomical data. AIPS is primarily used for reducing radio astronomy data.

ARL (Applied Research Laboratories) This facility is located on Burnet Road at Braker Lane in North Austin. Most positions at ARL are security-sensitive; thus, information is restricted on a NEED-TO-KNOW basis. Most of the research done at ARL is in acoustics and wave research.

ASA Astronomy Students Association, designed for astronomy majors but open to anyone interested in astronomy. The purpose is to provide support for undergraduates in the astronomy field, and to introduce students in general to the cool aspects of astronomy.

Astro This is the name of one of many computer systems operated by the UT Astronomy Department and McDonald Observatory. Astro is a Sun workstation running SunOS, a UNIX-based operating system. It is currently being upgraded to Solaris. If you are an Astronomy major you can get an account on this system.

Bee Caves Observatory A university site southwest of Austin off Bee Caves Road. There are two telescopes for general use, a 12-inch and a 25-inch. Currently, only the 12-inch works.

Bus Service Capital Metro of the city of Austin provides several bus services for students. On all normal buses, if you show your student ID, you can ride for free. There are also shuttle busses that go in, out and around UT for students.

Campus Mail You can send mail to anyone or any place on campus, free of charge, 1-2 day delivery.

Campus phones Campus phones are located around the campus for free usage. To dial anywhere on campus, dial the last 5 digits of the number. To dial off campus, dial nine first.

CCD Charge-coupled device, successor to photographic films in astronomical imaging. It is also used for obtaining spectroscopic data.

CCWF Computation Center Workstation Facility. UT's main computer facility for general student use. Internet address: ccwf.cc.utexas.edu.

Cloud magnet Slang for someone on their first real research oriented observing run who gets clouded out every night.

Colloquium The Astronomy and Physics departments offer weekly lectures during the regular school year. They are research oriented and difficult to understand but definitely worth the time.

Conference Course This is a class you register for to investigate a topic on an individual or small group basis with a faculty member. To enroll, the student must find his/her own advisor and topic.

Crown and Anchor This hamburger joint is very close to RLM and has cheap food and beer. A good place to hang out.

The Drag The several blocks of Guadalupe Street that run beside the university. This has become an outdoor mall that caters to mostly students and tourists. Lots to see, buy, and eat.

Dragworm or Dragrat A slang term for the large numbers of homeless people who congregate near Guadalupe. They often attempt to panhandle from students.

Edmonds Lounge A lounge on the 15th floor of RLM where cookies are served before colloquium talks. It is named after Frank Edmonds, a former faculty member of the astronomy department. It is used often for meetings, including ASA meetings, and many students use it as a place to study and work on problem sets.

Gregory Gym The main UT gym, it has been recently renovated.

HET The Hobby-Eberly Telescope. A huge new telescope at McDonald Observatory for spectroscopy. Formerly called the Spectroscopic Survey Telescope.

HRC The Humanities Research Center in the Harry Ransom Center. The HRC is a collection of old and rare books, microfilms, and historical items that is available for scholarly research. If you need to find firsthand accounts of Halley’s comet at the Battle of Hastings, go there.

HST The Hubble Space Telescope. It is run by NASA and STSci.

IRAF Stands for Image Reduction and Analysis Facility. This is a large set of data reduction programs for astronomy. It originally started out only for optical data, but gradually, more programs related to other types of astronomy were added. IRAF is found in all astronomy departments throughout the world, and you will probably learn how to use it.

Learning Skills Center Located in Jester center, this is a great source for anyone who wants to improve his learning skills from study techniques to note taking. Tutors for problematic courses such as math and physics are available for anyone who can afford them. If you are on financial aid you are automatically eligible for some free tutoring.

McDonald Observatory Located on Mt. Locke in West Texas, McDonald Observatory is the darkest place in the continental United States. Built with funding from the University of Chicago, telescope resources are still shared between UT and the University of Chicago. Occasionally the ASA takes a trip to McDonald Observatory. This trip is very fun and you should go if possible.

Painter Hall The old physics building and common location for undergraduate physics lectures. There is a 9-inch refracting telescope on the roof that is open for public observing on Fridays and Saturdays and available for any student to use otherwise, once you have been checked out.

PCL The Perry Castaneda Library. This is a great source for any historical research, including astronomy. It has the second longest library hours and is a lot quieter than other libraries. For deathly quiet, though, try the Biology library in the Main Building.

PDS A measuring device that digitally finds the locations of stars on photographic plates. The Astronomy Department has a PDS machine in a room just off of the library, where several undergraduates work. This room is called the "PDS Room."

Peridier Library A research library for the faculty, scientists, and graduate students in the Astronomy department. Located on the 15th floor of RLM. Not intended for undergraduate use, but under some special conditions, undergraduates are allowed to use the library.

Physics Circus At least twice a year the physics department puts on a big show demonstrating physical phenomena in a very entertaining fashion. It is very public and very popular.

Pickle Research Center (PRC) The J. J. Pickle Research Center is located next to ARL in Northwest Austin. As with ARL, many of the positions are security-sensitive.

PMA The Physics, Math, and Astronomy library located on the fourth (ground) floor of RLM. Contains professional journals, books, texts, and upper division reserve materials in physics, math, and astronomy.

Posse East Another place to hang out within walking distance to RLM. It has a big screen TV, food, and drinks.

Rec. Center The recreational sports center, located by the stadium. This new building has it all. Aerobics, free weights, racquetball, basketball, exercise machines, huge crowds and more.

Reducing Data The process of taking data and removing all background effects from it. This is followed by photometry, spectroscopy, or whatever. Many undergraduates' first experience with astronomical research is with reducing data. Data reduction is usually done on the computer with some sort of software like IRAF or AIPS (see those entries).

RLM Robert Lee Moore hall, the Astronomy, Math, and Physics building. As an astronomy major you will spend a lot of time there.

16-inch Telescope The telescope located on the 17th floor roof of RLM. (There is also a 14th floor roof.)

SMF Student Microcomputer Facility (a.k.a. "the Smurf'). A computer workroom on the second floor of the Undergraduate Library (UGL) with dozens of Macs and PCs. All the computers have full Internet access, laser and color printing, and some are equipped with flatbed scanners.

Harlan Smith Harlan Smith was a beloved professor of astronomy here at UT. Some of the high points of his astronomical career were proposing an observatory on the far side of the moon, and the optical variability of quasars. Dr. Smith died a few years ago of cancer.

Solar Telescope A telescope designed to safely observe the sun. It is located on the 14th floor roof and observed in a classroom on the 13th floor. Open for general use, prior scheduling required.

Star Date magazine A bimonthly publication put out by the McDonald Observatory Public Information Office (PIO).

Star Party A generic term used to describe more than one person observing for the fun of it. Regular public star parties take place on top of RLM and at Painter Hall, and occasionally out at Bee Caves. The star parties at RLM take place every Wednesday that class is in session. Painter Hall star parties are on Friday and Saturday nights. Friday is open to UT students, staff and faculty. Saturday night is open to the general public. The time varies depending on the time of year.

Sucker holes Small patches of clear skies on a cloudy night when one is trying to observe.

Sun system This usually refers to a high performance workstation developed by Sun Labs. One of the Sun systems that the astronomy department owns and operates is astro. It is also possible to get an individually funded account for the Sun workstations in the UGL through the Computation Center. You will get a small bill for usage each semester.

T.Q. Transient quarters at McDonald Observatory. These hotel-like accommodations are within walking distance of the domes and are where astronomers and invited guests stay during an observing run.

TEX The Telephone Enrollment Exchange for the University of Texas at Austin. Tex has other services such as telephone access to grades, emergency loans of $150.00, financial aid status, and more.

Tokomak The experimental fusion reactor that used to be in the basement of RLM.

UGL The Undergraduate Library ("the Ugly"). The library that has the longest hours. In addition, the UGL houses the Dean of Students' Office and two computer labs: the SMF with Macs and PCs and the ACWL with Sun workstations.

The Union Located by the main building and Guadalupe street, it houses many student services, places to eat, a bowling alley, a bar, a theater, and much more.

UNIX This is an operating system developed by AT&T. Many of the high performance workstations use either true UNIX or a variation of UNIX which typically only expands on the base UNIX operating system to accommodate the different computing needs of individuals. Astro and the Astronomy Department's many other workstations mostly use a UNIX operating system.

UTSEDS This group, formally named University of Texas Students for the Exploration and Development of Space, has a more general scope than ASA. ASA was originally started from people from UTSEDS. The national chapter of SEDS is located at the University of Arizona (UASEDS).

VAX On the UT Campus many departments actually own their own mainframes. A VAX is a large computer system built by Digital Equipment Corporation (DEC). There are two main operating systems used on these mainframes, Ultrix and VMS. Ultrix is the UNIX environment on the VAX systems.

Gerard H. de Vaucouleurs Dr. de Vaucouleurs was one of the most influential astronomers of this century. His research interests included extragalactic astronomy and cosmology, photometry, kinematics and dynamics of bright galaxies, HI line studies, studies of the Local Supercluster of galaxies, the cosmic distance scale and determining the Hubble constant. He was the author of the Third Reference Catalogue of Bright Galaxies (RC3), a landmark in modern extragalactic astronomy. Until his death in 1995, Dr. de Vaucouleurs held Emeritus status and was the Jane and Roland Blumberg Centennial Professor in Astronomy and a member of the USNational Academy of Sciences.

WET The Whole Earth Telescope, a worldwide network of optical observatories designed to make continuous observations of selected objects for several days. Locally headed by Dr. Don Winget and Dr. Ed Nather.

Appendix E

Some Web Addresses

The Anglo Australian Observatory
http://www.aao.gov.au/images.html

The Astronomical Society of the Pacific
http://aspsky.org/

The Astronomy Caf
http://www2.ari.net/home/odenwald/cafe.html

Astronomy Magazine
http://www2.astronomy.com/astro/

Astronomy Picture of the Day
http://antwrp.gsfc.nasa.gov/apod/astropix.html

Astronomy Students' Association
http://www.utexas.edu/students/astro

Comet Observation Home Page
http://encke.jpl.nasa.gov/

Hobby-Eberly Telescope
http://www.as.utexas.edu/mcdonald/het/het.html

HST Nuggets Home Page
http://scivax.stsci.edu/-hamilton/nuggets/hst-nuggets.html

Hubble Heritage Project

http://heritage.stsci.edu/

Hubble Space Telescope latest releases
http://www.stsci.edu/pubinfo/Latest.html

International Dark-Sky Association
http://www.darksky.org/~ida/

Mars Pathfinder Project Information
http://nssdc.gsfc.nasa.gov/planetary/mesur.html

McDonald Observatory
http://vc.as.utexas.edu/

NASA Goddard Space Flight Center Homepage
http://www.gsfc.nasa.gov/

NASA Jet Propulsions Laboratory
http://www.jpl.nasa.gov/

The NASA Homepage
http://www.nasa.gov/

NASA Human Spaceflight
http://shuttle.nasa.gov/index-n.html

The Nine Planets
http://dept.physics.upenn.edu/nineplanets/

NSSDC Photo Gallery
http://nssdc.gsfc.nasa.gov/photo_gallery/

Planetary Photojournal: NASA s Image Access Home Page
http://photojournal.jpl.nasa.gov/

Project Galileo
http://galileo.ivv.nasa.gov/

Satellite Visibility - Home Page
http://www2.gsoc.dlr.de/scripts/satvis/satvis.asp?Lat=30.2692&Lng=-97.7436&Loc=Austin&TZ=CST

SETI at Home
http://setiathome.ssl.berkeley.edu/

SETI Institute
http://www.seti-inst.edu/

Sky & Telescope
http://www.skypub.com

Sky & Telescope News Bulletins
http://www.skypub.com/news/news.html

Sky & Telescope Sights Page
http://www.skypub.com/sights/sights.html

Sky Chart
http://www2.gsoc.dlr.de/scripts/satvis/skyview.asp?lat=30.2692&lng=-97.7436&loc=Austin&TZ=CST

Stellafane Home Page
http://www.stellafane.com/

UASEDS
http://www.seds.org/

USNO Master Clock Time
http://tycho.usno.navy.mil/what.html

UT Astronomy Department
http://www.as.utexas.edu/

UT Austin Web Central
http://www.utexas.edu/

UT Physics Department

http://www.ph.utexas.edu/

Welcome to the Planets
http://pds.jpl.nasa.gov/planets/