ASTR 2401

Careers in Astronomy and Astrophysics

Observational Astronomy

Many of these slides were adapted from a presentation by
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Labs This Week

- Observing Labs Start at 5:45 - **PROJECTS**
- **Bring your observing plan and finder charts**
- 8:00 for alternate lab on campus
- Tonight ?????

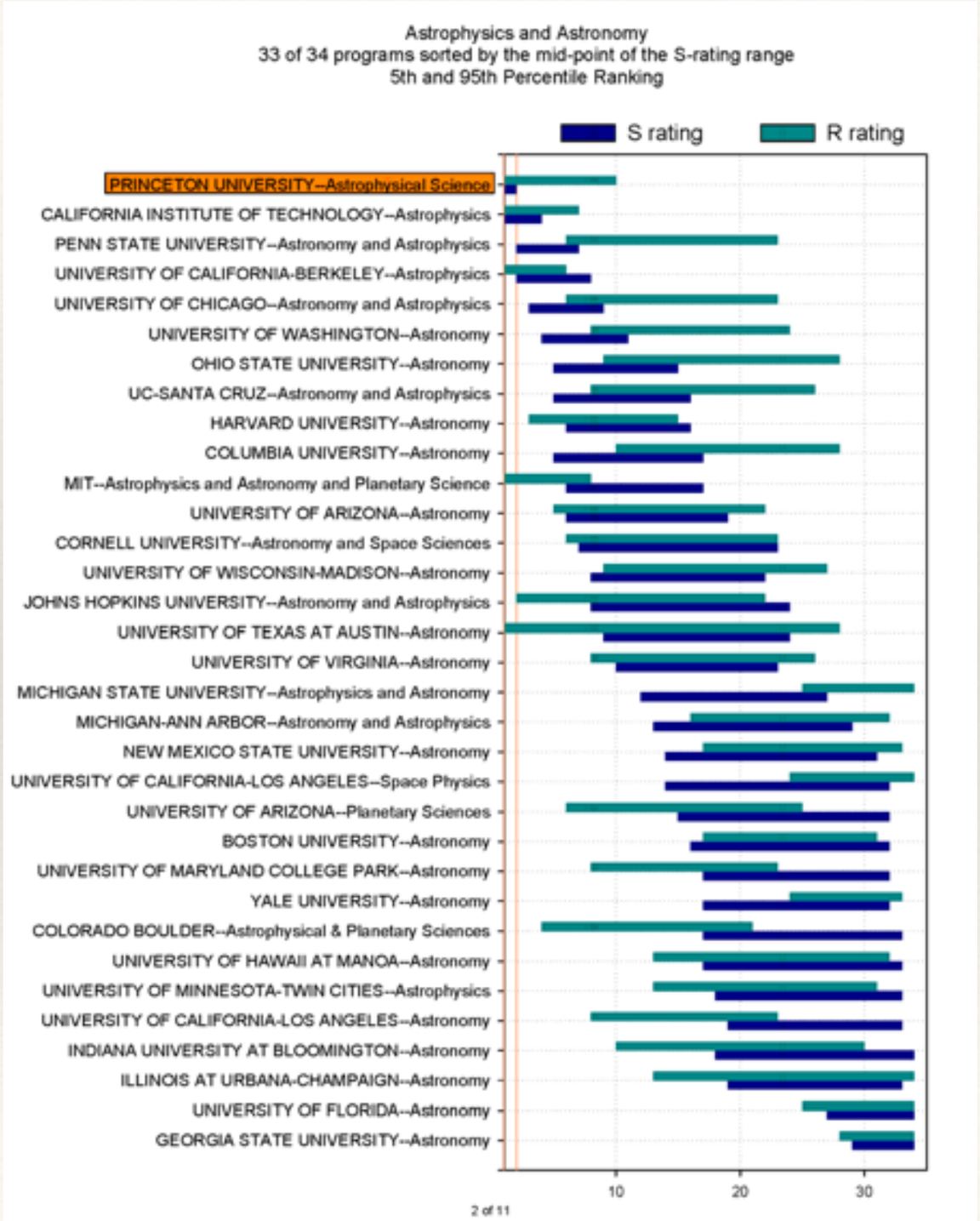
What Kind of Careers Are Available to Astronomers?

Ph.D. level jobs:

- Professor at a College or University (~55%)
  - Research universities (PhD program)
    - Examples: Columbia, Texas Tech, Penn State, University of Florida
  - Teaching universities (Terminal BS or MS)
    - Examples: Swarthmore, Queens University of Charlotte, Aquinas College

The number of professorial jobs in astronomy and astrophysics at major research universities is limited.

– About 35 US universities offer Ph.D.s in astronomy and astrophysics and many of these are actually in physics departments



What Kind of Careers Are Available to Astronomers?

Ph.D. level jobs:

Researcher or Support Scientist at a Government- funded observatory, institute, or laboratory (~33%)

Carnegie Observatories
National Optical Astronomy Observatories
National Radio Astronomy Observatory
National Solar Observatory
Space Telescope Science Institute
International Gemini Observatory
NASA Goddard Space Flight Center
NASA Ames Research Center
Jet Propulsion Laboratory

What Kind of Careers Are Available to Astronomers?

Ph.D. level jobs:
- Private industry (~10%)
  - Southwest Research Institute
  - Space Science Institute
  - Aerospace Corporation
  - Ball Aerospace
- Planetaria, science museums, etc. (~2%)
  - American Museum of Natural History

PhD Jobs outside academia

Software Development
Finance (quants)
Data Science (Huge right now)
Consulting
Science Writing/Communication
Technical Writing
(Science) Management
Science Policy

Jobs You Can Get With a Bachelor of Science in Astronomy

Data technician/analyst
Science educator
Science librarian
Science writer
Planetarium/museum director
Instrument technician
Telescope operator/night assistant

Path for an Academic Career

Career Stage	Objectives
Undergraduate	Learn fundamentals of physical science, begin to develop research skills, earn B.S. degree, gain admission to graduate school.
Graduate	Learn to carry our original research, develop research skills, earn Ph.D. (and title “Doctor”), obtain a good temporary postdoctoral (“postdoc”) position.
Postdoc	Broaden experience and skills, build research reputation, carry out original research, obtain a permanent or “tenure- track” position.
Faculty	As an “assistant professor” (probationary), establish yourself as a leader in research in your field. Obtain grants, carry out research, publish research results, obtain tenure and promotion to “associate professor”.

Note on titles: “Doctor” is someone who has earned a Ph.D. degree. “Professor” is a job title: assistant, associate, and “full” professors are simply addressed as “Professor.” Nearly all professors are also doctors.

“Typical” Academic Career Path for Research Astronomers

Undergraduate (4 years Bachelor of Science)
Major in Astronomy and Astrophysics or Physics
Less often: Chemistry, Math, Engineering

Graduate (~5-7 years Doctor of Philosophy [PhD])
Astronomy or Physics
Often earn Master of Science along the way
Typically 2 years of classes + research, followed by original research leading to a dissertation
Graduate students receive tuition waivers and stipends
GTAs, GRAs, and Fellowships
Typical stipends ~20-30,000

“Typical” Academic Career Path for Research Astronomers

Postdoctoral Research (total ~2 to 6 years)

Real, full-time job, but fixed term (usually 2-3 years)
Usually full-time research

Two principal categories
- Fellowship : free to work on projects of your own choosing
- Research Assistant: hired to work on a specific project or program

“Typical” Academic Career Path for Research Astronomers

Assistant Professor/Assistant Astronomer

Permanent position, but probationary
In no later than sixth year, a tenure† review takes place

Successful: promotion to Associate Professor with Tenure at the beginning of next year.
Unsuccessful: termination of position at the end of the following year.

- Typically final outcome is a faculty position at a lower-tier university

†“Tenure” refers to a guarantee of a position until retirement. Can be revoked for cause or if unit is dissolved or institution is insolvent.

“Typical” Academic Career Path for Research Astronomers

Position	Undergrad	Grad	Postdoc	Asst Prof
Salary	N/A	~$24k	$40-75k	$50-90k
Time	4 yrs	5-6 yrs	2-6 yrs	< 7 yrs
Cumulative Time	4 yrs	9-10 yrs	11-16 yrs	13-22 yrs

Later career salaries (major research universities):
Associate Professors: $75-100k
Professors: $90->200k

What Should I Be Doing as an Undergraduate Astrophysics Major?

Position yourself for graduate school

Focus on your classes strong academic preparation in physics and math

Get active in the scholarly life of the department

Start going to seminars and colloquia now

Astronomy group meeting every other Wednesday (conference room 2:00pm)

email Rob Coyne [rob.coyne@ttu.edu] to get on the list

Obtain research experience (**you must do this**)

End of second year is a good time to start (Probably no later).

Spend your first and second years concentrating on mastering calculus and physics.

Computer programming experience

Python is becoming the de facto standard language for astronomy

Take every opportunity to learn new, marketable skills

Don’t neglect the development of good writing skills!

What Should I Be Doing as an Undergraduate Astrophysics Major?

Preparation for applying to graduate school should begin your third year

Which grad school you attend is in most cases one of the most important factors in your future career*

Consider your strengths and weaknesses

Be honest with yourself

Most ***graduate schools*** will not consider your application if your GPA is lower than ~3.0

Set realistic goals and expectations

(Apply to a couple reach and a couple safeties as well)

***But a good thesis advisor is the most important factor! The reputation of your advisor trumps the reputation of the school.**

The GRE

The General GRE (Verbal, Math, Writing) is required for entry all graduate programs

The Physics GRE is still required for the majority of programs, but is slowly falling out of favor at more progressive institutions

A poor score is not a deal breaker (I did very, very badly), but it will shut doors

You need to prepare and prepare well for the test. Take the time to study, review and prepare.

Consider taking the physics GRE early (Spring 3rd year) as practice.

You can not take the GRE any later than the Fall you start applying to grad schools.

Preparation for applying to graduate school should begin no latter than your third year!

You need **3 recommendation letters**, at least two of these should be faculty you've done research with.

Leave plenty of time for graduate school applications in autumn of your final year, it takes way more time then you think!

Most require a personal statement and a summary of past research.

Give letter writers plenty of notice and time, start asking late spring and summer. Try to give letters writers **six weeks lead time**, at least

Application deadlines vary, the season is mid-November through Early January with a peak around December 15th and the first week in January

If you are offered a spot, you will be invited to visit at their expenses as a "prospective", you may also be notified about being on a wait list

You usually have to accept by April 15th, this can cause a scramble at the last minute, you might still get on offer after this date!

You must do research as an undergrad if you want to go to grad school.

How Can I Get Research Experience As An Undergraduate?

Knock (email) on your professor's doors and ask them about their research

Your research can be in physics too, don't think you are limited to just the Astronomy profs here

Some professors may have money to pay for research

The TTU Center for Active Learning and Undergraduate Engagement (CALUE) has undergrad project funding you can apply to

PHYS 3000 - Undergraduate Research

How Can I Get Research Experience As An Undergraduate?

Many observatories and universities have summer programs ("Research Experiences for Undergraduates" [REU])

Check the website of the American Astronomical Society
Seek advice from astronomy faculty and more senior students regarding specific programs

NSF REU Program
https://www.nsf.gov/crssprgm/reu/

One program, but you have to apply to sites individually

Due dates are February-ish, but vary, so check early!

Tips for doing research with faculty

Clear Communication
- Don’t oversell yourself
- Ask questions if you don’t know something
- Check in, give status updates
- Don’t be afraid to ask for help
- Grad students and post-docs in the group can be a resource

Dedication
- Commit significant time, make it a priority
- Don’t vanish
- Meet with you advisor regularly
- Be prepared for meetings
- Stick with you project

Two Bonus Tips

Go to the American Astronomical Society (AAS) Winter Meeting

- It's a chance to present your research in talk (rare) or a poster (most likely)
- But most important, it is a place to network/meet faculty from places you are applying too, this can be a huge benefit!

Apply for the NSF Graduate Research Fellowship

- You can apply once as an undergrad and once as a grad student
- Having your own funding for 3 years and the prestige of the fellowship can open doors for you

Timeline*

	Fall	Spring	Summer
Year 2	Start going to talks Get to know profs	Start looking for research Maybe apply to REUs	Summer research project
Year 3	Start thinking about grad school Keep doing research	Look for external research (REU) Keep doing research Consider Taking general GRE/ practice physics GRE	External or local Summer Research Start selecting Grad Schools
Year 4	Keep doing research/start senior capstone project Take GRE Apply to grad schools Apply to NSF GRF	Attend AAS Meeting (January) Visit Grad Schools Finish up research projects	Huzzah! You are going to grad school!

*Always keep making good grades

Plan B

Postbach
- Informal
  - A researcher with funding hires you to do research
- Formal
  - Columbia

Bridge Programs (most designed for underrepresented groups)
- Fisk-Vanderbilt
- Princeton

Terminal Masters as a bridge
- Wesleyan
- San Francisco State

Balance Sheet on Astronomy as a Career

Upsides

Most astronomers love their jobs

Most astronomers choose what they work on

Interesting experiences and world travel

You will never be bored

Gratification of making a lasting contribution to science

Downsides

Few options as to where you'll live

"Deferred compensation" (good salaries come late)

Highly competitive nature of field demands long hours of hard work, dedication, sacrifice, and patience without much personal recognition

Research is risky business