Careers in Astronomy

AST 200
Astronomy

- **Primary Goal**: Understanding the nature of the universe and its constituents
- **Means**: Equipment building, research, teaching
- **Primary Vocational Path**: B.S., M.S., Ph.D.
General Areas of Study

- **Solar** – the study of the sun
- **Planetary** – the study of planets, comets, asteroids, debris around other stars
- **Stellar** – the study of stars
- **Galactic** – the study of our Galaxy
- **Extragalactic** – the study of other galaxies
- **Cosmology** – the study of the origin & evolution of the universe
Education

- **Undergraduate**: Physics &/or Astronomy major (sometimes Math & Engineering as well)
- **Graduate**: Physics &/or Astronomy

1) Two years of classes

2) Four years of thesis research (observational, theoretical, instrumentation)
<table>
<thead>
<tr>
<th>Research Experiences of Physics Undergraduates</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working with a professor on a project</td>
<td>35</td>
</tr>
<tr>
<td>As part of a thesis project</td>
<td>28</td>
</tr>
<tr>
<td>Non-departmental employment</td>
<td>26</td>
</tr>
<tr>
<td>(e.g. Summer job)</td>
<td></td>
</tr>
<tr>
<td>Research Experience for Undergraduates</td>
<td>25</td>
</tr>
<tr>
<td>(REU-Funded by the National Science Foundation)</td>
<td></td>
</tr>
<tr>
<td>While in a Co-op or internship</td>
<td>14</td>
</tr>
<tr>
<td>None</td>
<td>27</td>
</tr>
</tbody>
</table>

The total adds to more than 100% as seniors were permitted to indicate more than one type of research experience.

Source: Survey of Physics Seniors, 2001
What Do Physics Bachelors Do?

<table>
<thead>
<tr>
<th>Type of Job</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software</td>
<td>28</td>
</tr>
<tr>
<td>Engineering</td>
<td>17</td>
</tr>
<tr>
<td>Science &amp; Lab Technician</td>
<td>10</td>
</tr>
<tr>
<td>Management, Owner &amp; Finance</td>
<td>19</td>
</tr>
<tr>
<td>Education</td>
<td>12</td>
</tr>
<tr>
<td>Active Military</td>
<td>5</td>
</tr>
<tr>
<td>Service and Other Non-Technical</td>
<td>9</td>
</tr>
</tbody>
</table>

Type of employment of physics bachelors 5 to 7 years after earning their degrees, 1999.

Source: 1998 Bachelors Plus Five Study
Typical Starting Salaries for Physics Bachelors, Classes of 1999 & 2000

Average Salaries Offered by Campus Recruiters to New Bachelors in Selected Majors, 2000

- Computer Engineering: $50,200
- Computer Science: $49,100
- Chemical Engineering: $48,900
- Electrical Engineering: $48,600
- Mechanical Engineering: $46,000
- Physics: $42,500
- Mathematics: $41,800
- Civil Engineering: $37,900
- Finance and Economics: $37,800
- Accounting: $36,700
- Chemistry: $35,900
- Political Science: $32,400
- Communications: $30,500
- Life Sciences: $29,100
- Psychology: $28,800
- Secondary School Teacher: $26,500

Source: National Association of Colleges and Employers
What’s Important?

Importance of knowledge and skills for physics bachelors, 5 - 7 years after degree

Primary Field of Employment

Engineering, Math & Science

Software

- Scientific problem solving
- Synthesizing information
- Mathematical skills
- Physics principles
- Lab or instrumentation skills
- Scientific software
- Knowledge of physics
- Modeling or simulation
- Product design
- Computer programming
- Software development

Percent “Very Important”

Percentage of physics bachelors who chose 4 or 5 on a 5-point scale where 5 = essential.

How Long Does It Take to Get a Physics PhD?

This graph depicts the number of full time equivalent years of graduate study completed by the PhD class of 2000.

Source: Initial Employment Report
Postdoctoral work

- The graduate phase is followed by one or more 2 to 3-year research positions
- These are *transitional* jobs
These data describe a PhD's employment, six months after graduation, by dissertation field. Those working in other temporary positions are not shown.

Source: Initial Employment Report, Class of '97 & '98
Primary Source of Support for Physics Doctoral Students.
US Citizens Only

Source: Graduate Student Survey, 2000-2001
Permanent Jobs

- Telescope Operator
- Telescope Support Scientist
- Staff job (at JPL, STScI, etc…)
- Professor
Telescope Operator

- Operates the Telescope for Visiting Astronomers
- Night job, often at high elevation
- Works in shifts, e.g., 3 – 4 nights on, 3 – 4 nights off
Telescope Support Scientist

- Typically affiliated with a specific **instrument** on a telescope
- Aids visiting observers in becoming familiar with the working of the instrument
- On standby most of the time
Staff Scientist

- Work primarily in **NASA-supported** facilities
- Examples: Jet Propulsion Lab (JPL), and the Space Telescope Science Institute (STScI)
- Instrument support, software support, management
- Typically, 20-50% of time is devoted to research
Professor

- Teaching
- Research
- Grant Writing
- Supervising Graduate Students
- Committees
Types of Faculty Jobs

- Theorist
- Observational Astronomer
- Instrument Builder
Salaries

- **Graduate Student**: $20 (± 10) K
- **Postdoc**: $40 (± 5) K
- **Support/Staff/Professor**: $80 (± 20) K

**Note 1**: Some faculty members & managers make a lot more than this!

**Note 2**: Salary is also dependent on location
Typical Salaries for PhD Physicists Early in Their Careers, 2000

Typical salary ranges for PhDs who have worked for less than five years

FFR&DCs are Federally Funded Research and Development Centers.
Some university salaries are for a full year of work, while others are paid only for the 9 to 10 month academic year.

Source: 2000 Salary Report
Research – Scientific Detective Work

- Hypothesis
- Tools/Sample to Test Hypothesis
- Propose for Observations
- Obtain Observations
- Reduce & Analyze data
- Modify Hypothesis
- Etc.
Where are these Telescopes?
On Mountaintops…

Mauna Kea, Hawaii
In Desert Valleys…

Owens Valley, California
In Space...

Hubble Space Telescope
Example: Observing in Owens Valley
Example: Keck Telescope
Potential Problems

Clouds

Ice

Software/Hardware Malfunctions
Grant Money

- National Aeronautics & Space Administration (NASA)
- National Science Foundation (NSF)
- Private Donors
Alternative Careers for Those Who Have Studied Astronomy

- Computer-related Work (Software Development, System Administrator, etc.)
- Business School
- Finance

- I.e., Jobs that Require Logic, Math, & Computer Skills
Why Astronomy is Presently Such a Great Vocation

- Fast & Cheap Computers
- Large Aperture Telescopes
- Space-based Telescopes & Space Probes
- The Internet
Exciting Discoveries over the Last ~ 10 Years -

- The Kuiper Belt & its Bearing on the Nature of Pluto
- Extrasolar Planets
- Supermassive Black Holes in Nearby Normal Galaxies
- Galaxies at High Redshift
Goals for the Next 10 Years

- Survey the universe & its constituents
- Use the universe as a unique lab for probing the laws of physics not accessible on Earth
- Search for life beyond Earth, & if it is found, determine its nature & its distribution
- Develop a conceptual framework that account for all that astronomers have observed