Employment in Astronomy: Present & Future

AAS Employment Committee Session

Panelists:
Beryl Benderly, Rachel Ivie, Jim Ulvestad,
Steve Beckwith, (Dana Lehr)

Organizers:
Anil Seth (Harvard-Smithsonian CfA)
Marcos Huerta (AIP Congressional Fellow)
Motivation: With ambitious future instrumentation plans, who is needed to make these successful and what will their impact be on astronomy employment.

Purpose:
1. Examine current astronomy employment demographics and trends and what drives them.
2. Discuss what the future looks like and what we’d like it to look like.

Format:

Each panelist will make a short presentation followed by a question and answer session.
- Data from Metcalfe 2008 (AAS job register, NST+NASA budget)
- Steady increase in Federal budget
- Huge increase in postdocs
- Flat research & support trend
Panelists

• Beryl Benderly, award winning journalist, covering science labor force issues for Science Careers for >6 years.
• Rachel Ivie, Assistant Director of the Statistical Research Center of the American Institute of Physics.
• Jim Ulvestad, NRAO, member of the decadal survey demographics panel.
• Steve Beckwith, Vice-President of Research & Graduate Studies, University of California (former director of STScI, MPIA)
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Statistics on Astronomy Workforce

Rachel Ivie
Statistical Research Center
Number of Astronomy Degrees

Source: National Science Foundation Survey of Earned Doctorates
Facts about Astronomy & Astrophysics PhDs

• 70 (+/- 10) % are US citizens or permanent residents
• 10-15% leave the US after getting their PhDs (meaning 85-90% are seeking employment in the US)
• In recent years, 60-70 % go straight into postdocs.

Source: NSF Survey of Earned Doctorates and AIP Initial Employment Survey
<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astronomy Only Departments</td>
<td>580</td>
<td>620</td>
</tr>
<tr>
<td>Astronomers in Physics Departments</td>
<td>1020</td>
<td>1060</td>
</tr>
</tbody>
</table>

Source: AIP Academic Workforce Survey
<table>
<thead>
<tr>
<th>Recruitment Area</th>
<th>2006</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astronomy Only Departments</td>
<td>25</td>
<td>24</td>
</tr>
<tr>
<td>Physics Departments</td>
<td>No Data</td>
<td>163</td>
</tr>
<tr>
<td>Total</td>
<td>-</td>
<td>187</td>
</tr>
</tbody>
</table>

Source: AIP Academic Workforce Survey
Percent of Full-Time Equivalent Faculty Employed in Temporary or Non-Tenure Track Positions: Astronomy and Physics Departments, 2008

Degrees Awarded by Department %
Astronomy only 22
Physics or Physics & Astronomy (PhD) 13
Physics or Physics & Astronomy (Master’s) 20
Physics or Physics & Astronomy (Bachelor’s) 20

Source: AIP Academic Workforce Survey
Some Serious Data Gaps

- Don’t really have a good count of astronomy PhDs (NSF~200, AIP~250)
- Don’t know how many non-US citizens with postdocs eventually leave
- Don’t know how many are hired at any level from outside US
- Don’t know how many recruited positions will actually be filled
To Fill in Some Data Gaps

• We are conducting a longitudinal study of astronomy graduate students with AAS
• Special Session 23 at 2:00 today
Astronomy Faculty
Results from the 2008 Survey of Physics & Astronomy Degree-Granting Departments
Rachel Ivie, Arnell Ephraim & Susan White

A Closer Look at Astronomy Faculty

In 2006, we began asking departments that offer degrees in physics or in physics and astronomy to tell us about faculty members who specialized in astronomy or astrophysics for their dissertation research. We combine this information with data collected from 37 departments that offer degrees in astronomy only to take a closer look at astronomy faculty. For the 2007-08 academic year, we estimate that 620 full-time equivalent (FTE) faculty members were employed by the 37 departments that award degrees in astronomy only. In addition, we estimate that there were 1,060 astronomers employed in 430 departments that award degrees in physics or physics and astronomy (out of a total of 763 such departments). The data are provided in Table 1.

http://www.aip.org/statistics
Visit http://www.aip.org/statistics

For more information

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Statistical Research Center
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Astronomy Employment
Outside Academia, Now and
in the Future

Jim Ulvestad
January 4, 2010
Available Faculty Positions

- AIP Data (see R. Ivie talk)
  - Currently 200-250 Astro PhDs/yr in US
  - Currently 1700 Astro faculty jobs in US

- Simple calculation
  - Assume no net influx/outflow of PhD recipients
  - Assume faculty career of 30 years
  - In 30 years, US will produce 6000-7500 Astro PhDs for 1700 faculty jobs
    - Oversubscription ratio of 4:1, if you assume every Astro PhD is seeking a faculty position
What Fraction of Astronomers are Faculty?

• AIP data and assessment of AAS full members show that about 40% of US-based astronomers are faculty at PhD-granting institutions, while about 15% are faculty at non-PhD institutions.

• This means roughly 45% of self-described “astronomers” are not faculty.

4 January 2010
Non-Faculty Astronomer Employment

- NASA science centers (STScI, CXC, SSC, HEASARC)
- NASA centers (JPL, Goddard, Ames, MSFC, etc.)
- “Beltway bandits” (CSC, SAIC, etc.)
- NSF facilities (NRAO, NOAO, NSO, NAIC, Gemini)
- Foundation/university observatories (Keck, CARMA, CSO, LBT, SMA, Magellan, Carnegie, SAO, Kavli, etc.)
- Industry (Ball Aerospace, Northrop-Grumman, etc.)
- Museums (AMNH, Hayden, Griffith, etc.)
- Research institutes (SwRI, SSI, etc.)
- Other teaching/support/software positions
Future Trends in Astro Research

- Consolidation of national funding into fewer, more expensive telescopes?
  - E.g., ALMA, GSMT, IXO, JDEM, JWST, LISA, LSST, SIM, SKA
- Borders between astronomy and physics will be increasingly blurred
- Increasing reliance on large surveys and public data sets, rather than individual observations
  - More time-domain astronomy
- Guidance from Astro2010?
Some Other National Trends

- Increased emphasis on STEM literacy and relation to economic development
  - Teaching skills will be more important
  - Astro PhD increase might not be accompanied by increased number of faculty positions
- Need to work with large data sets will be common across scientific disciplines
  - Data management
  - Automatic and parallel processing
  - Visualization
Some interesting suggestions from community for changing training of “astronomers”

- Broader training in areas such as science policy, teaching, data-handling, instrumentation, program management
  - Minors or areas of emphasis for each department?
- Cross-disciplinary degree programs (e.g., astro + computer science)
- Professional Masters programs
Hiring Outlook in Academia

Steven Beckwith
Vice President for Research & Graduate Studies,
University of California
Director Emeritus, Space Telescope Science Institute
& Max-Planck Institute for Astronomy
California contains 12% of the US population

UC has ~8% of the US research university population

- 170,000 undergrad, 35,000 grad, 15,000 medical/health
- 10,000 faculty, 1,000 in physical sciences, 134 astro
  - ~500,000 total US faculty, all institutions
- UC researchers typically get ~8% of total US grants by $
- 134 astro faculty, 8% of 1700 total (Ulvestad)

UC enrollment and hiring plans track California demographics, i.e. US demographics
Projected Student Population

Figure 2.4. U.S. Public and Nonpublic High School Graduates 1996-97 to 2002-03 (Estimated), 2003-04 to 2021-22 (Projected)

Source: Western Interstate Commission for Higher Education: Knocking at the College Door

Note: The most recent estimates for most states’ nonpublic school graduates were for 2002-03. The most recent actual data for public school graduates were for 2004-05.
• Annual growth of 1.5% 2011-16, then 1.1% 2017-21.
• 52% faculty over 50 yr old; 10% over 65;
• New hires + replacement: ~7 UC astro faculty/yr next decade (12% of Ulvestad US estimate: 1700/30 = 57/yr)
UC Faculty Hiring

Annual appointments of ladder-rank faculty, UC system, 1984/5 – 2004/5

Physical Sciences

Astronomy faculty ~13% total
(50 PS => 7.5 Astro)

- Men: 703 (83.7%)
- Women: 137 (16.3%)
- Total: 840
Which Regions are Growing?

Figure 2.22. Percent Change in Public and Nonpublic High School Graduates by State, 2004-05 to 2014-15
Astrophysics: Budget forward look

FY2010 President's Budget and Estimates for 2011 - 2023

- Assumed operating missions beyond 2016 include JWST, SOFIA
- HST De-orbit mission development ramps up ~2020
ADDITIONAL SLIDES
PhDs in Astronomy by Citizenship

Source: National Science Foundation Survey of Earned Doctorates
Percentage of PhDs from Astronomy Only Departments who Left U.S. Upon Graduation

Source: AIP Initial Employment Survey
Number of astronomy and astrophysics PhDs who remain in US and number of these who took postdocs

Source: AIP Initial Employment Survey
### Number of Astronomy Degrees Earned by African Americans and Hispanics, 1997-2006

<table>
<thead>
<tr>
<th>Type</th>
<th>All Astronomy</th>
<th>African Americans (US citizens)</th>
<th>Hispanics (US citizens)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PhDs</td>
<td>1790</td>
<td>11</td>
<td>35</td>
</tr>
<tr>
<td>Masters</td>
<td>1194</td>
<td>11</td>
<td>20</td>
</tr>
<tr>
<td>Bachelors</td>
<td>2700</td>
<td>25</td>
<td>60</td>
</tr>
</tbody>
</table>

Cells contain ten-year totals

PhDs—National Science Foundation Survey of Earned Doctorates.
Masters—National Center for Education Statistics
Bachelors—American Institute of Physics Enrollments and Degrees Survey.
Percentage of Astronomy Degrees Earned by Women

Source: National Science Foundation Survey of Earned Doctorates
PhDs 1997-2006

Source: National Science Foundation Survey of Earned Doctorates
New astronomy and astrophysics PhDs who take postdocs, by sex, 2005 and 2006.

Source: AIP Initial Employment Surveys
## Astronomy Faculty Members who are Under-represented Minorities, 2008

<table>
<thead>
<tr>
<th></th>
<th>African Americans</th>
<th>Hispanic Americans</th>
<th>Total, all races</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Astronomy Only</strong></td>
<td>5</td>
<td>12</td>
<td>620</td>
</tr>
<tr>
<td><strong>Departments</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Physics Departments</strong></td>
<td>190*</td>
<td>278</td>
<td>9200</td>
</tr>
</tbody>
</table>

*95 of these work at HBCUs.

Source: AIP Academic Workforce Survey
<table>
<thead>
<tr>
<th>Faculty Members Who are Women</th>
<th>2006 %</th>
<th>2008 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astronomy Only Departments</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Physics Departments</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>Astronomers in Physics Departments</td>
<td>NA</td>
<td>18</td>
</tr>
</tbody>
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Source: AIP Academic Workforce Survey
<table>
<thead>
<tr>
<th>Academic Rank</th>
<th>2003</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full professor</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Associate professor</td>
<td>23</td>
<td>24</td>
</tr>
<tr>
<td>Assistant professor</td>
<td>23</td>
<td>28</td>
</tr>
<tr>
<td>Instructor / Adjunct</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Other Ranks</td>
<td>15</td>
<td>21</td>
</tr>
<tr>
<td>Overall</td>
<td>14</td>
<td>17</td>
</tr>
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Source: AIP Statistical Research Center