

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)

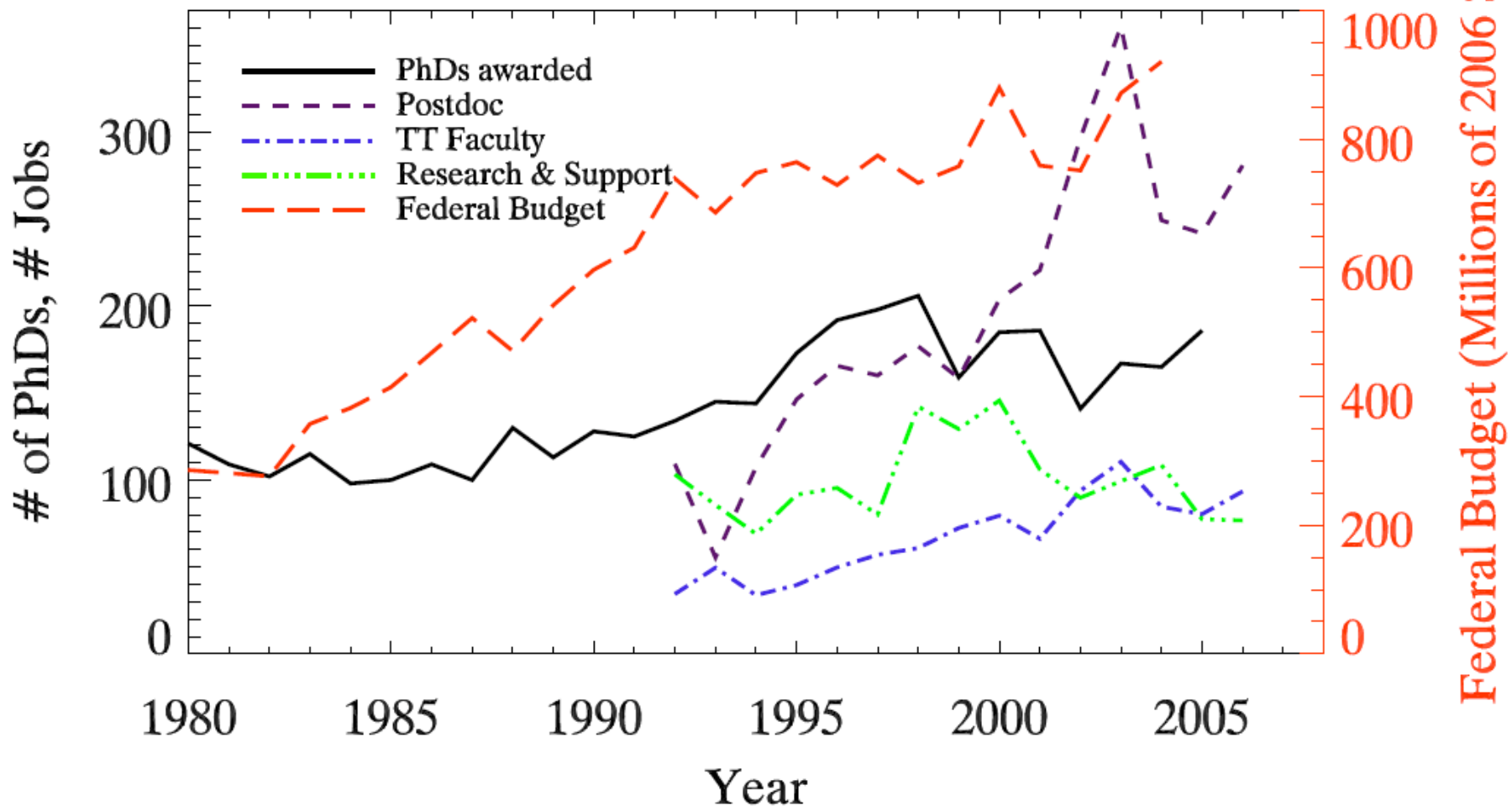
Motivation: With ambitious future instrumentation plans, who is needed to make these successful and what will their impact be on astronomy employment.

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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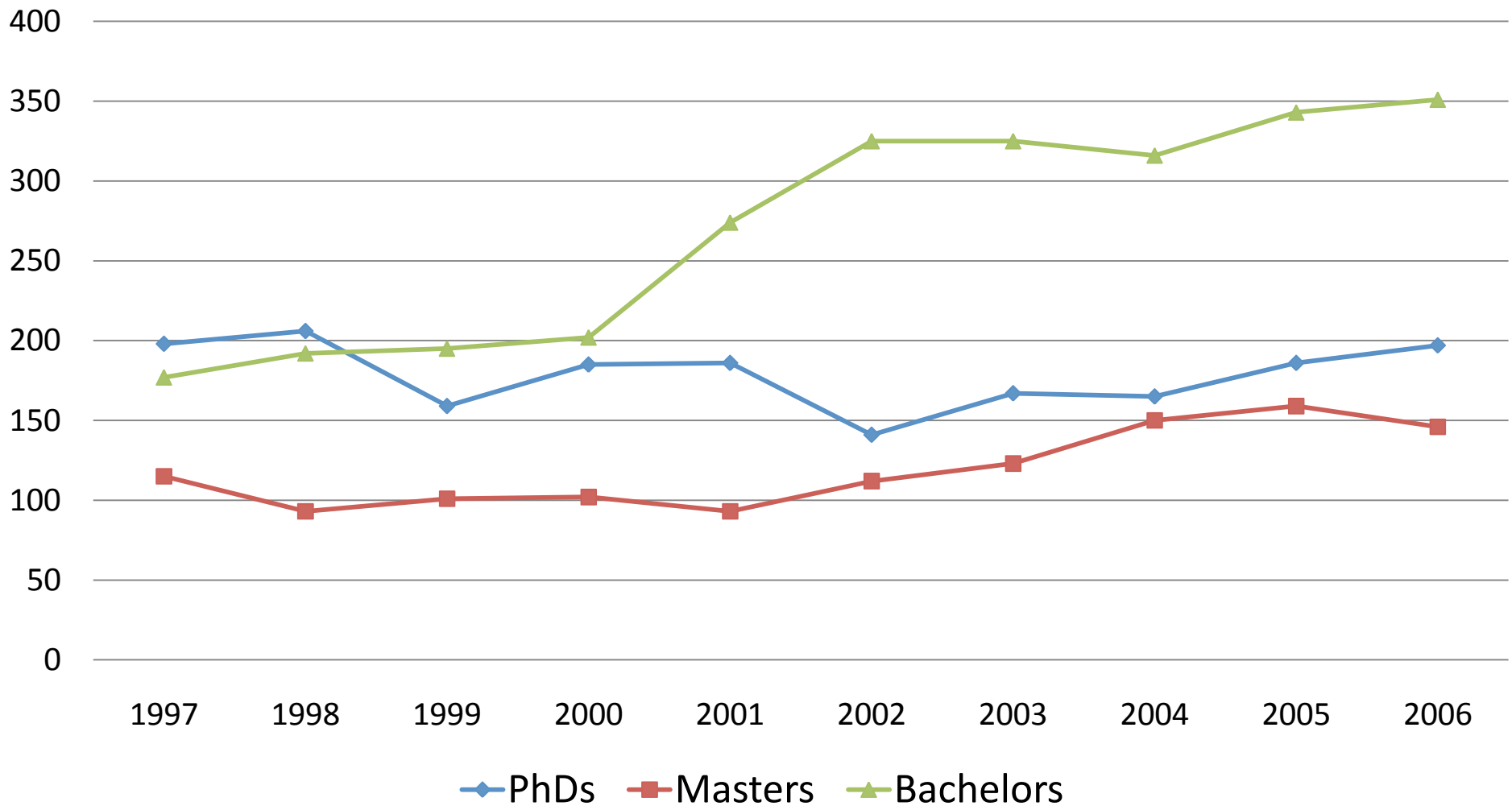
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Statistics on Astronomy Workforce

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

Number of Faculty Members in Astronomy

	2006	2008
Astronomy Only Departments	580	620
Astronomers in Physics Departments	1020	1060

Source: AIP Academic Workforce Survey

Recruitments for Astronomy and Astrophysics Tenured & Tenure-Track Faculty

	2006	2008
Astronomy Only Departments	25	24
Physics Departments	No Data	163
Total	-	187

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

REPORTS ON PHYSICS & ASTRONOMY FACULTY

Number of Physics Faculty
(10/2009)

Astronomy Faculty
(12/2009)

Minorities among Physics &
Astronomy Faculty (2/2010)

Hiring in Physics &
Astronomy Departments
(4/2010)

Women Faculty in Physics
& Astronomy (6/2010)

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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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

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

Astro2010 White Papers

- 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*



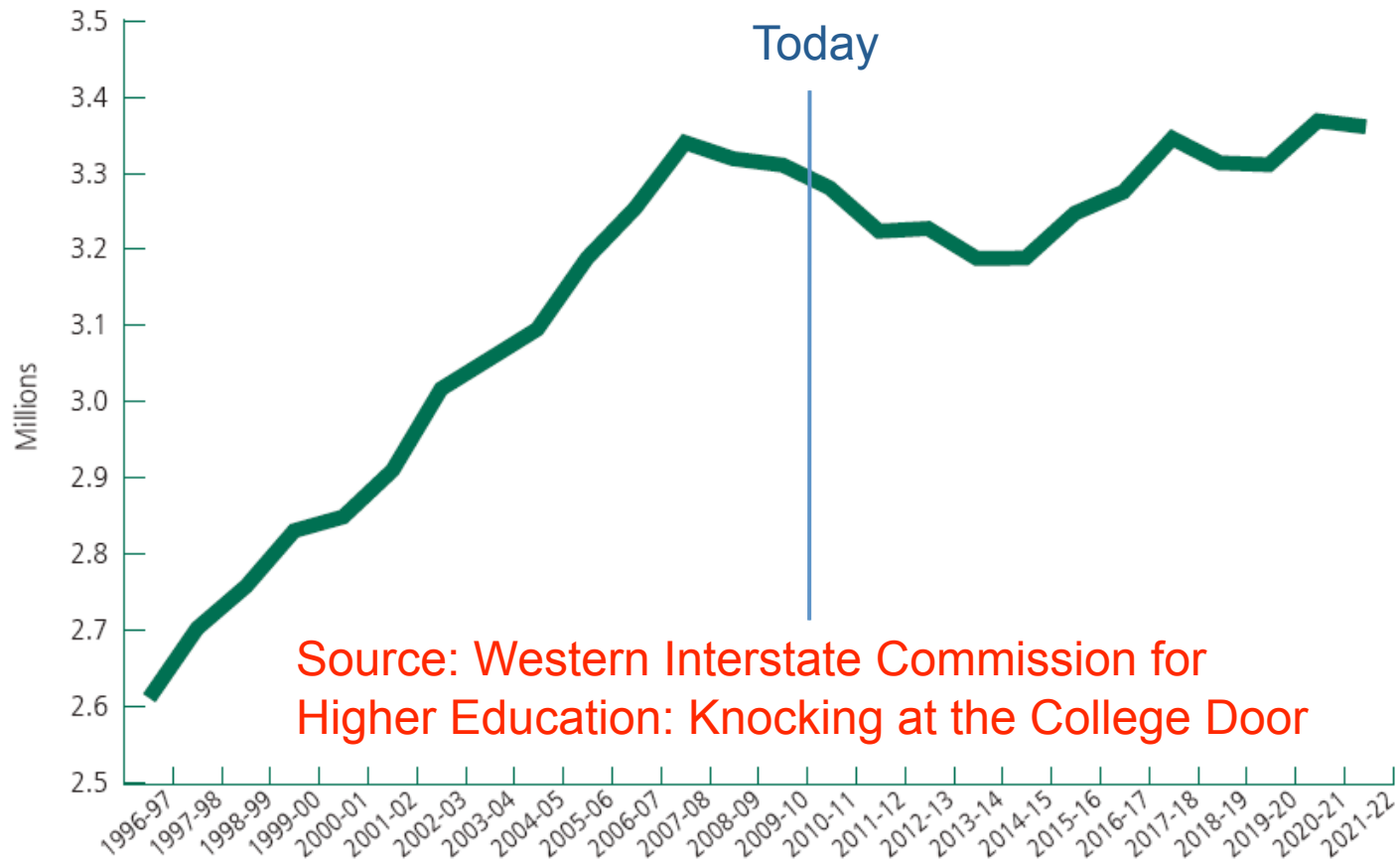
The University of California

- 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)

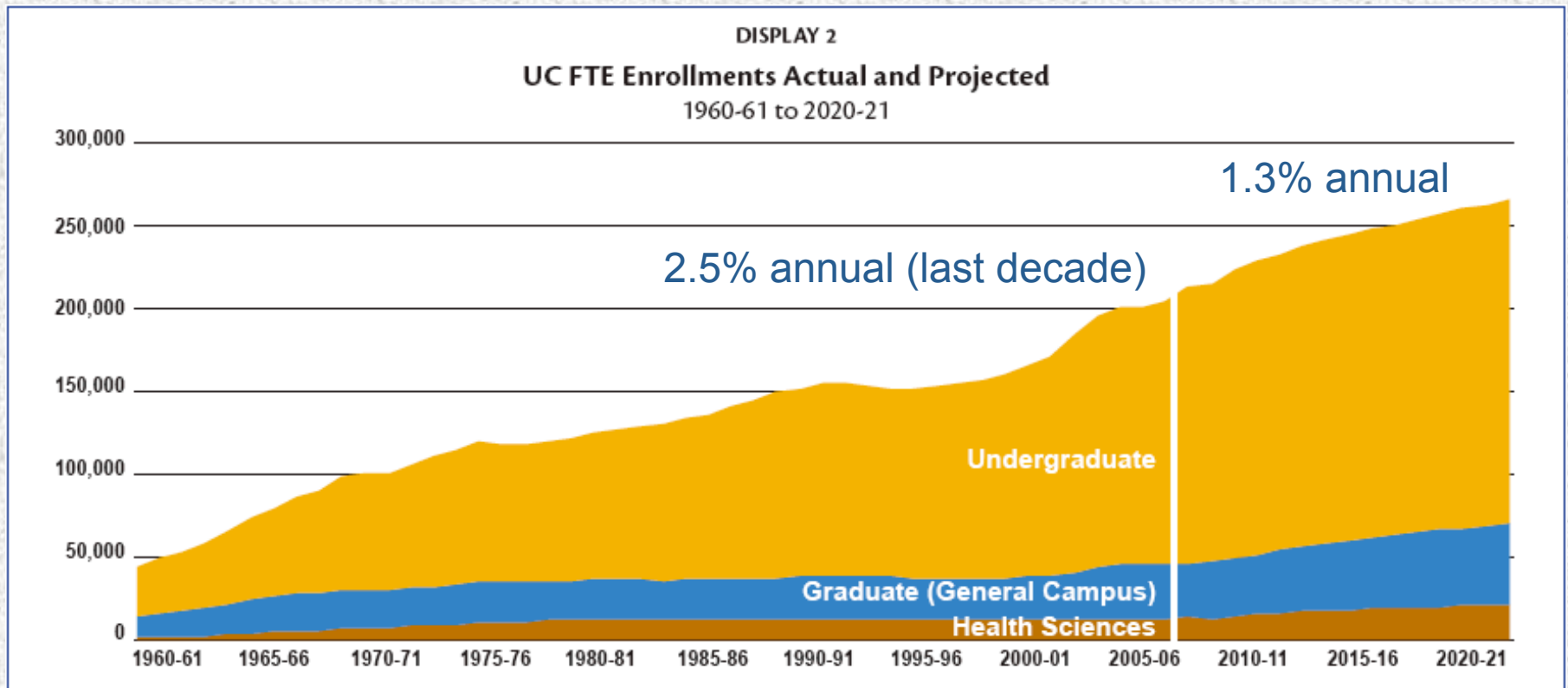


Source: Western Interstate Commission for Higher Education: Knocking at the College Door

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.



UC Student Enrollments



- 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: $1700/30 = 57/\text{yr}$)

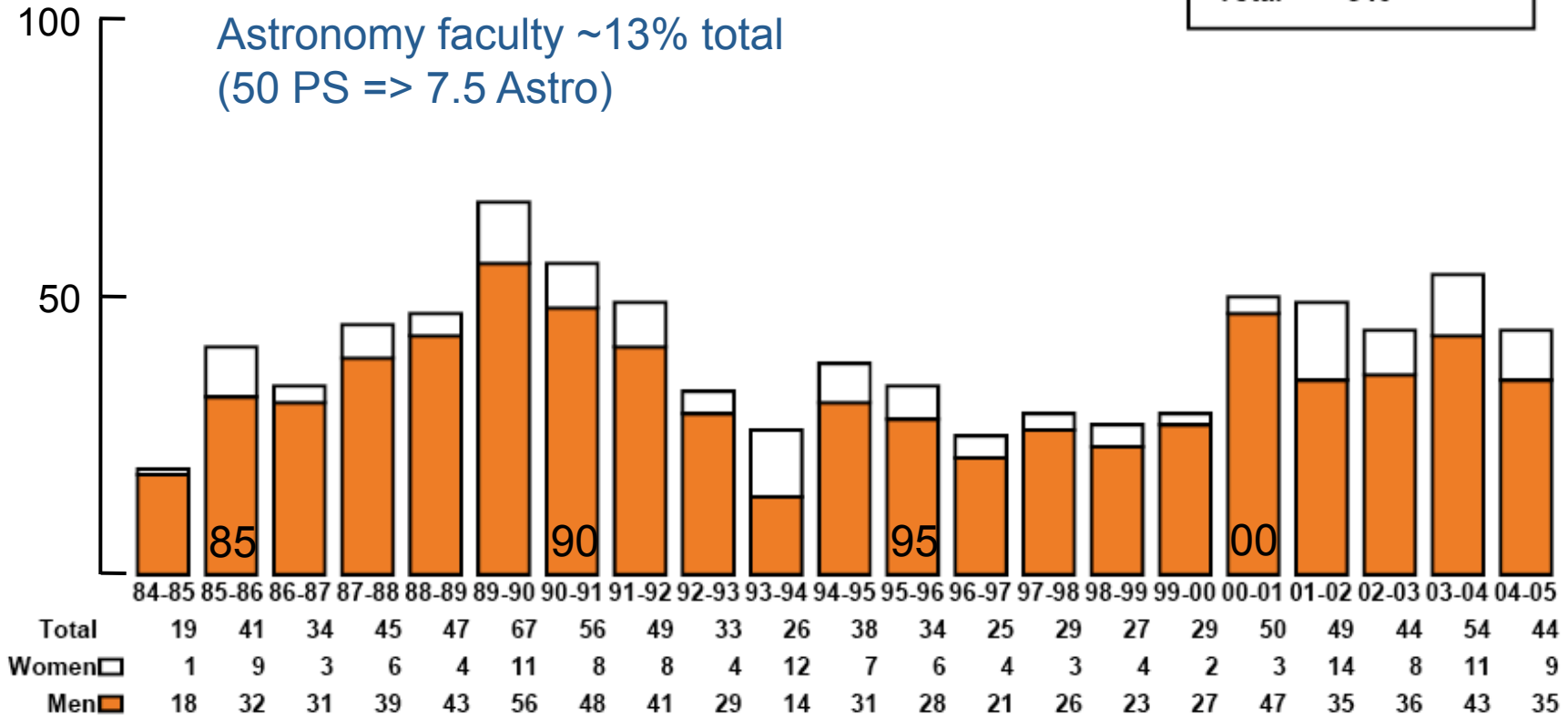


UC Faculty Hiring

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

Physical Sciences

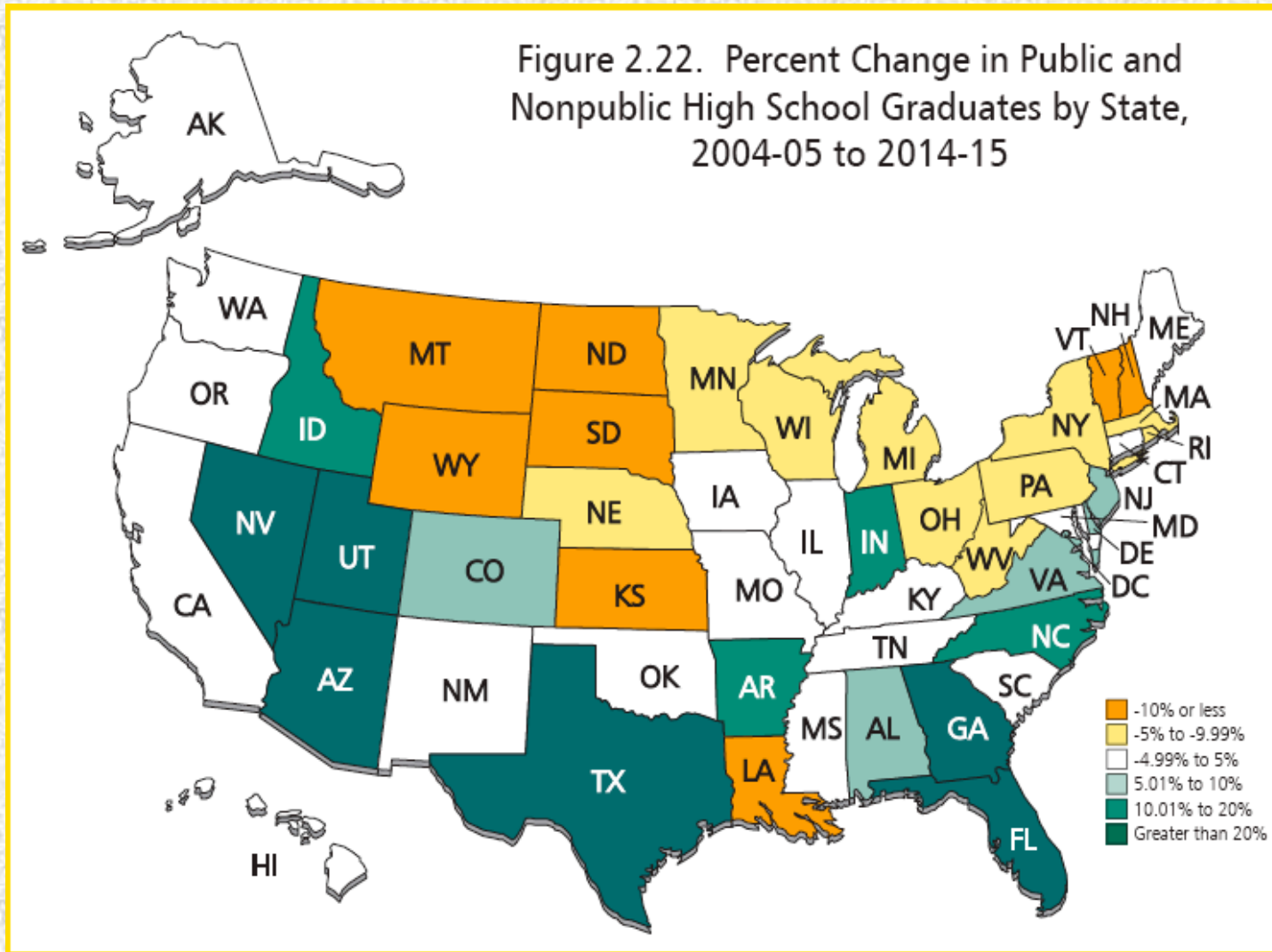
Men	703 (83.7%)
Women	137 (16.3%)
Total	840



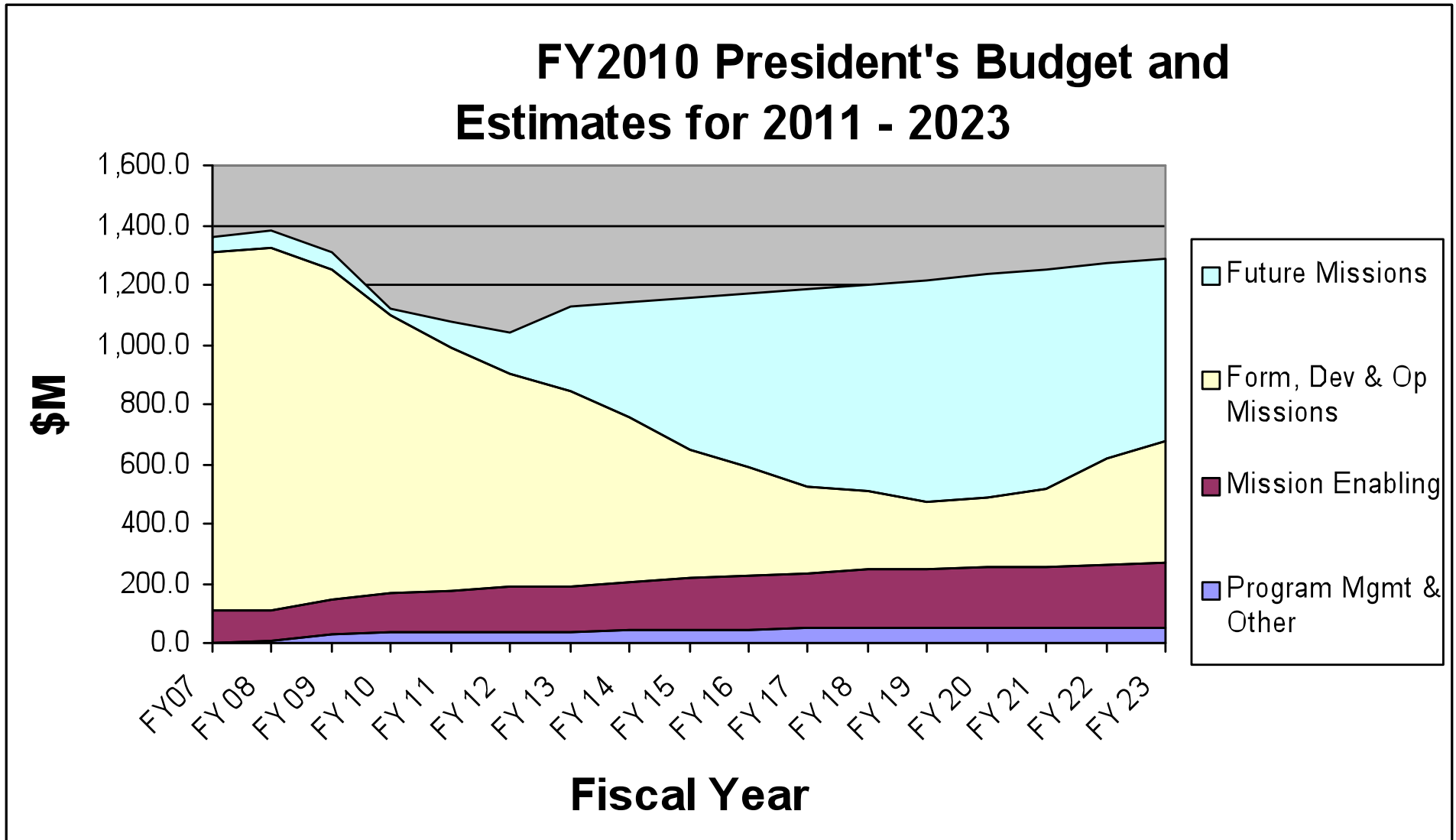


Which Regions are Growing?

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



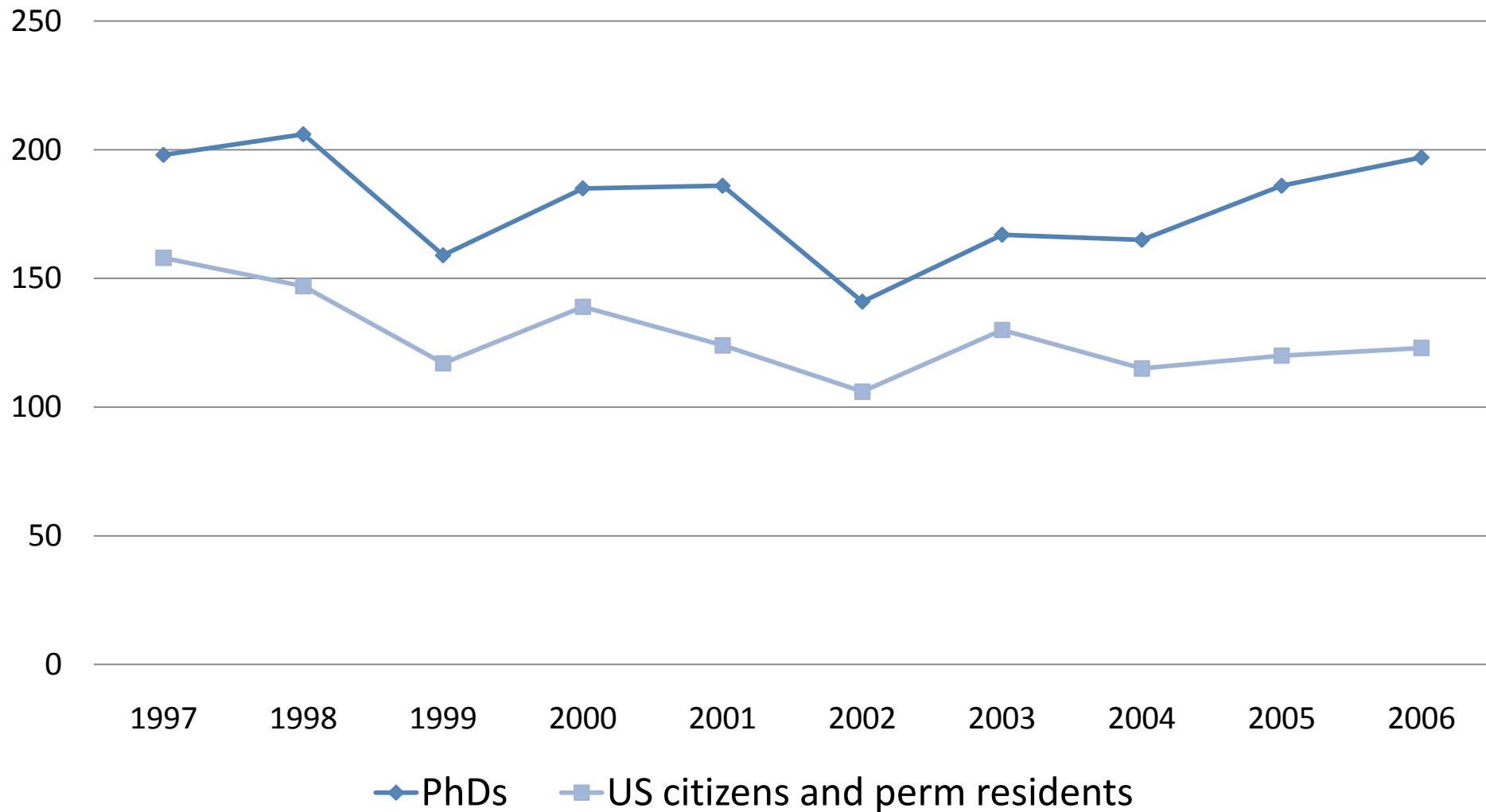
Astrophysics: Budget forward look



- Assumed operating missions beyond 2016 include JWST, SOFIA
- HST De-orbit mission development ramps up ~2020

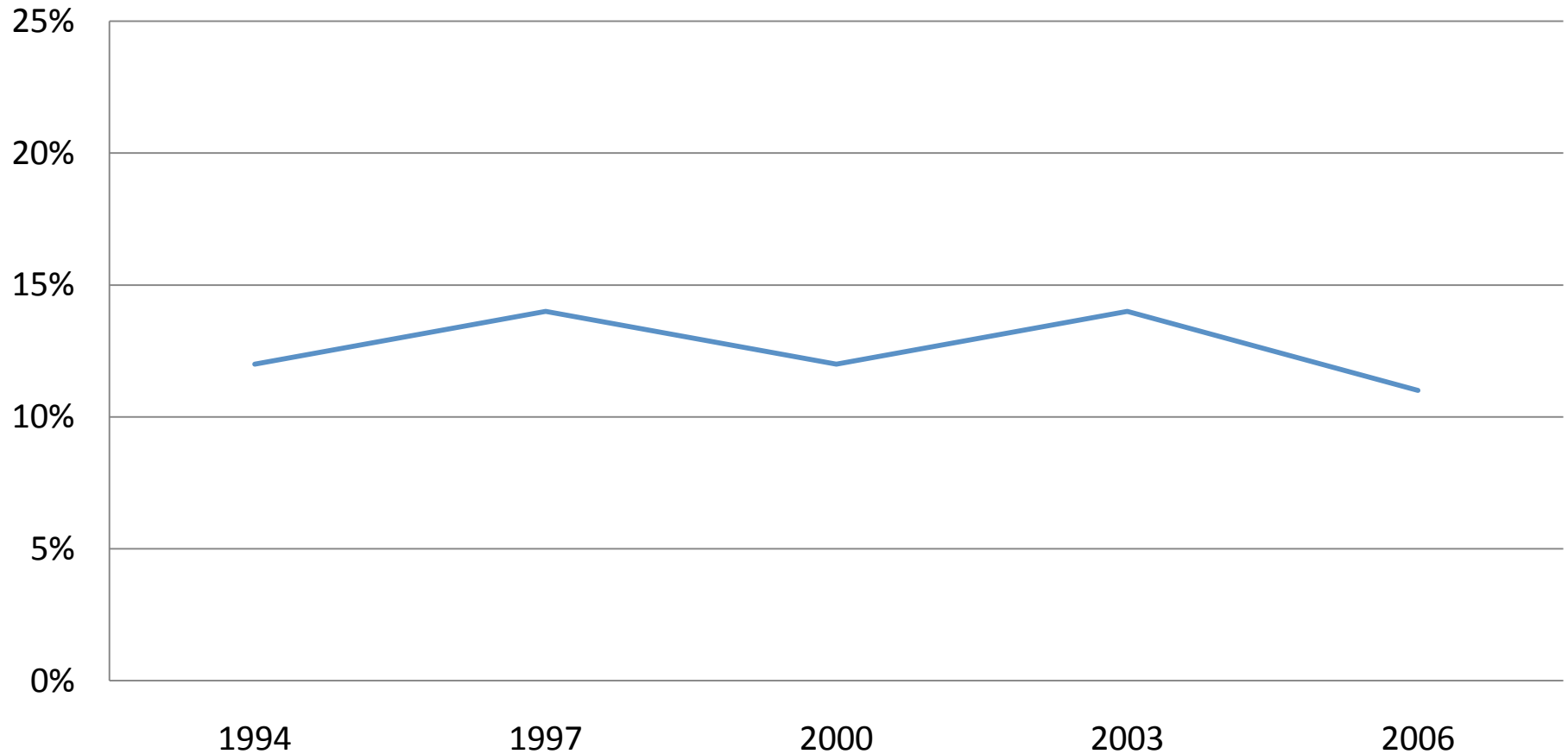
ADDITIONAL SLIDES

PhDs in Astronomy by Citizenship



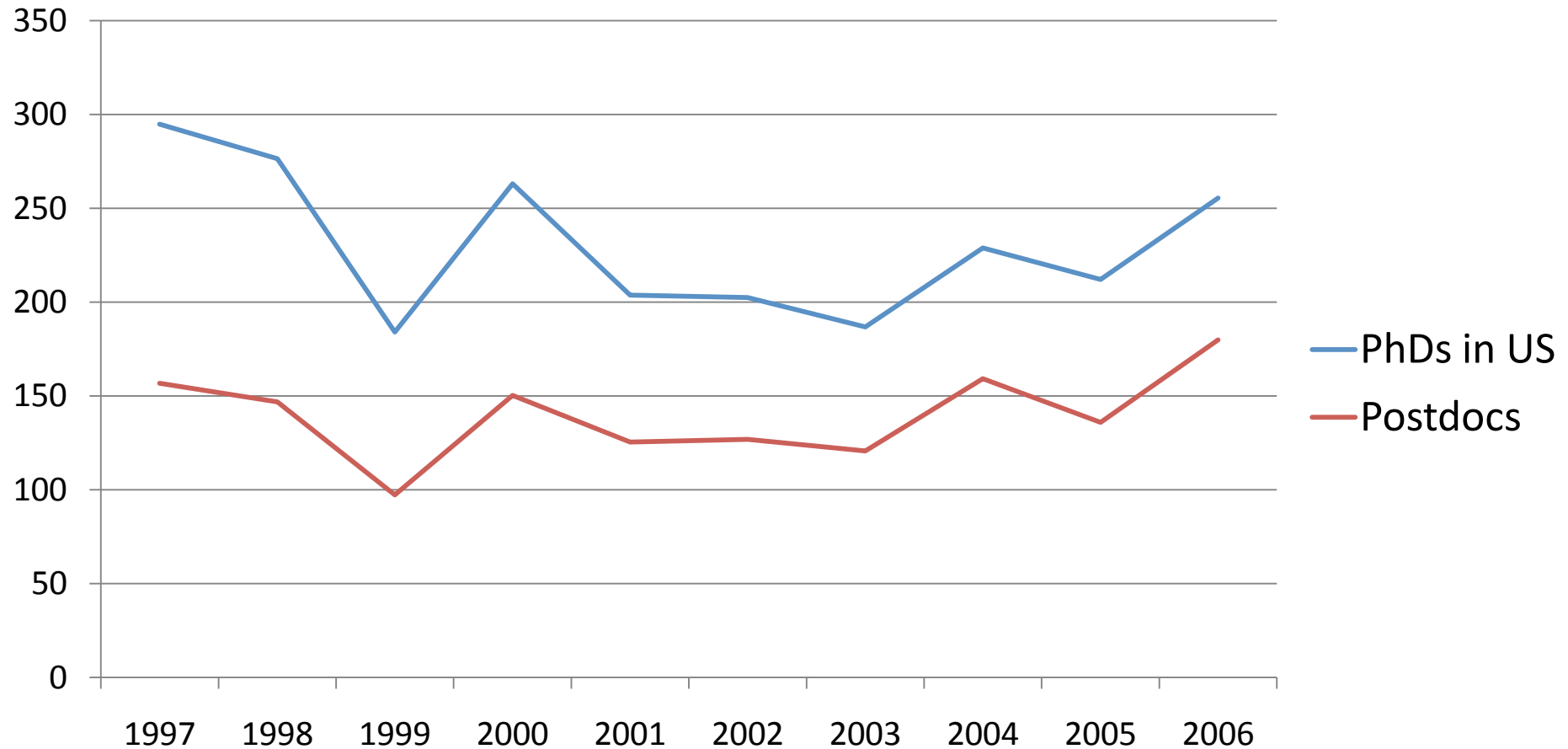
Source: National Science Foundation Survey of Earned Doctorates

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

	All Astronomy	African Americans (US citizens)	Hispanics (US citizens)
PhDs	1790	11	35
Masters	1194	11	20
Bachelors	2700	25	60

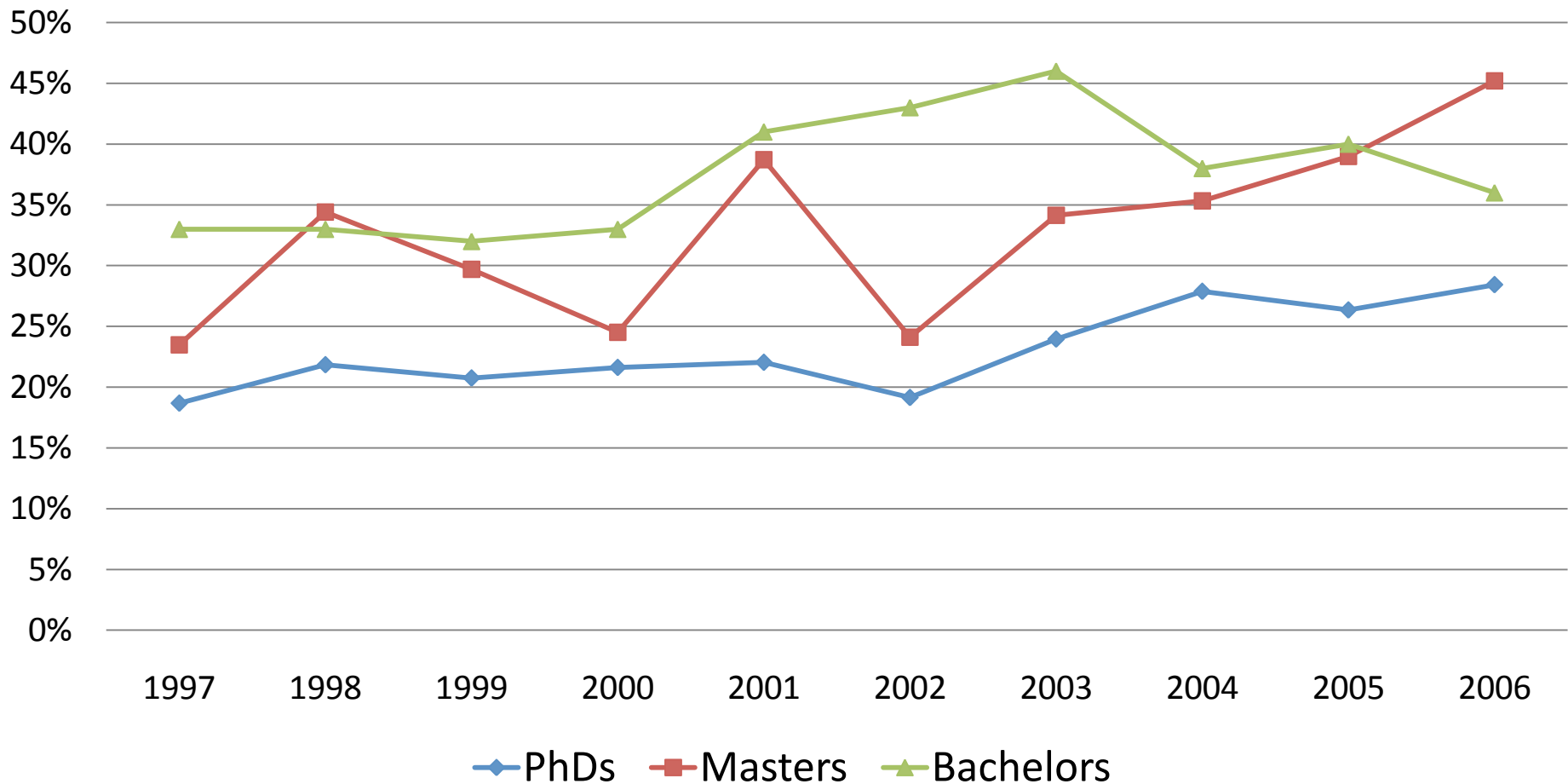
Cells contain ten-year totals

PhDs—National Science Foundation Survey of Earned Doctorates.

Masters—National Center for Education Statistics

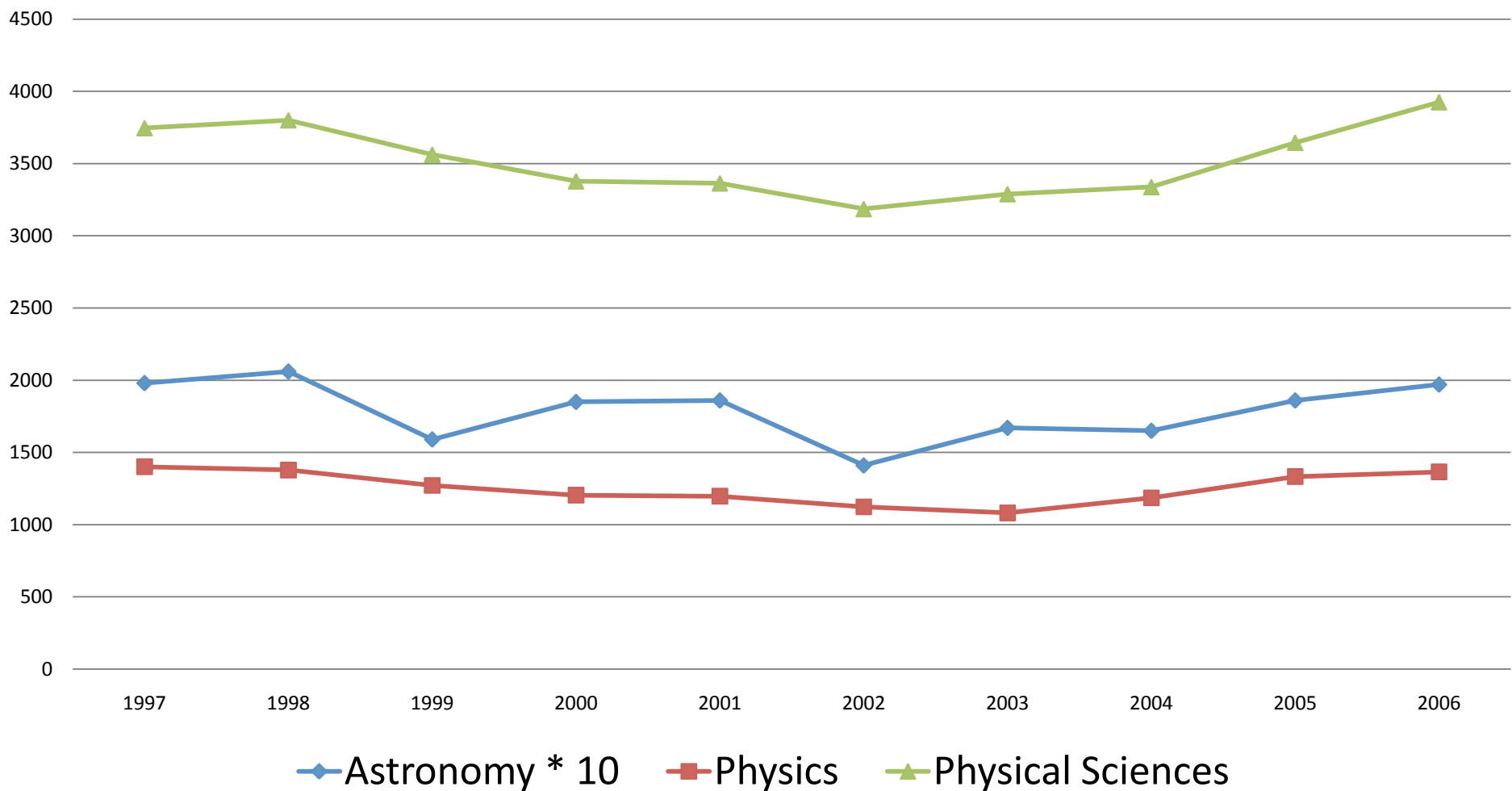
Bachelors—American Institute of Physics Enrollments and Degrees Survey.

Percentage of Astronomy Degrees Earned by Women



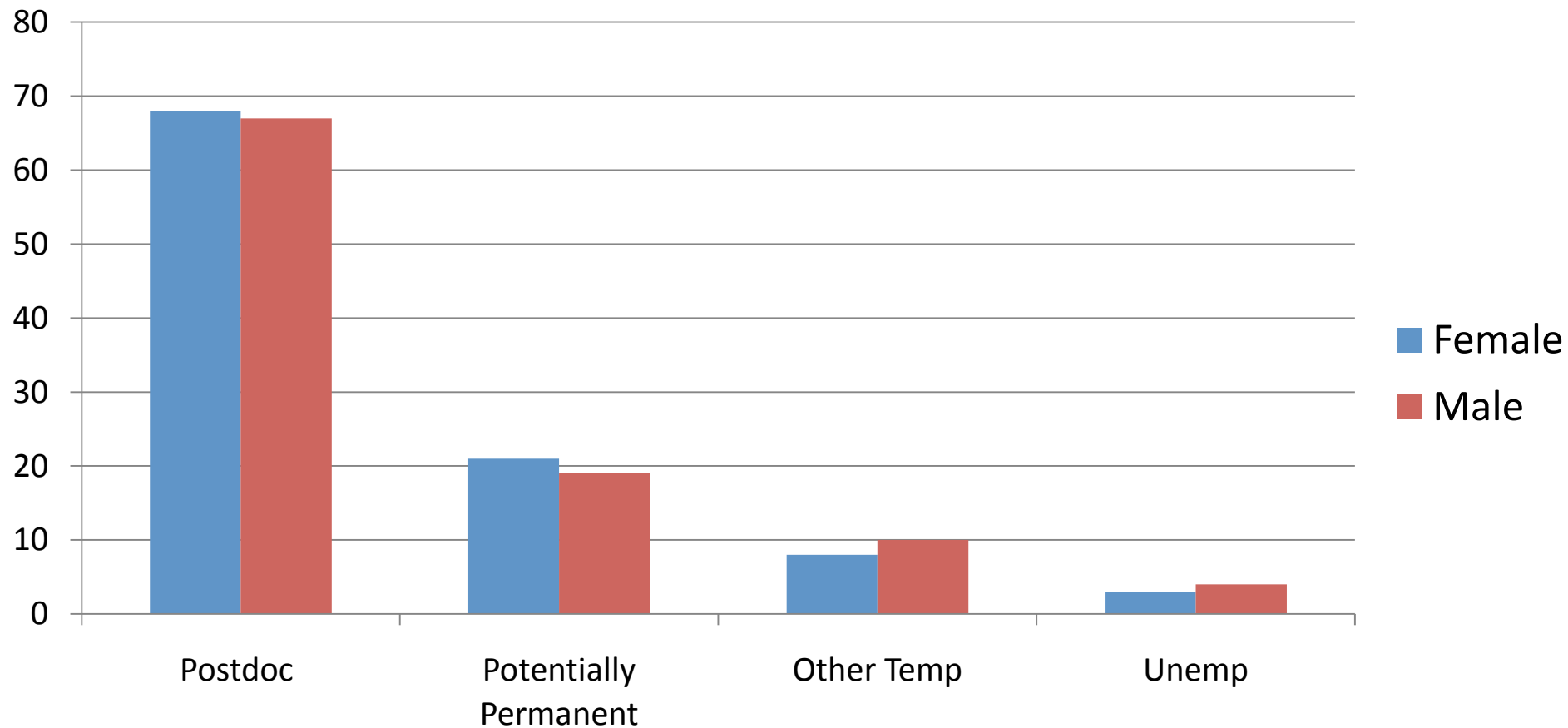
Source: National Science Foundation Survey of Earned Doctorates

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

	Number		
	African Americans	Hispanic Americans	Total, all races
Astronomy Only Departments	5	12	620
Physics Departments	190*	278	9200

*95 of these work at HBCUs.

Source: AIP Academic Workforce Survey

Faculty Members Who are Women

	2006 %	2008 %
Astronomy Only Departments	17	17
Physics Departments	13	12
Astronomers in Physics Departments	NA	18

Source: AIP Academic Workforce Survey

Percent of Faculty Positions in Astronomy Only Depts. Held by Women

Academic Rank	Year	
	2003	2006
Full professor	10	11
Associate professor	23	24
Assistant professor	23	28
Instructor / Adjunct	15	15
Other Ranks	15	21
Overall	14	17

Source: AIP Statistical Research Center