Women in Astronomy Workshop 2014

Demographics

Sarah Maddison
Swinburne University
Aims of the ASA WiA Chapter

• Primary goals:
  1. monitor the status of women working in Australian astronomy via **collection of statistics**
  2. **recommend future actions** that will improve the environment for all astronomers
• Assist the community to ensure **appropriate representation** for women at scientific meetings and on high-level decision making committees
• **Organise WiA meetings** at ASM (+ workshops like this!)

Astronomy Australia Ltd (AAL) has upcoming vacancies on its Board and Committees, with applications from women strongly encouraged.

Call for applications will be announced via the ASA email exploder in mid-Sept.

Great opportunity to contribute your expertise and ideas, and play a leadership role in Australian astronomy.

AAL reviewed its demographic representation following 2011 WiA workshop, setting a target of at least the proportion of women in the astronomy community (using the Decadal Plan demographic data to set the benchmark)
(1) Why do we need demographic data?

• Often reported that:
  
  – number of women in astronomy positions is not increasing at a rate commensurate with the availability of qualified female students, and
  
  – women are not represented at highest levels

  ➔ statistics needed to support these claims

• To monitor the status of women in astronomy we need the data to see temporal trends
(1) Why do we need demographic data?

“For the last 29 years more women have graduated from Universities than men. But men have a 9x better chance of becoming senior executives”  [Bain & Co 2013]

In the top 500 ASX companies, women are only:
- <3% of “Chairmen”
- 9% of Non Executive Directors
- <3% of Chief Executive Officers
- 9% of Key Executives (and 8% across listed cos.)
  [WGEA Workplace Gender Equality Agency 2013]
(1) Why do we need demographic data?

First representation gap of women in science arises as early as Bachelor level and continues throughout the scientific career.
(2) What data do we need?

- gender and status statistics within (astro) academia:
  - % women students (undergrads & PhDs)
  - % junior women (postdocs & contracts)
  - % tenured women (years past PhD & status)
- gender & status within organisations (ASA, NCA, Academy of Science, IAU…)
- visibility of women:
  - % high-level executive committees
  - % awards & prizes
  - % invited speakers
  - % grant recipients
(3) How do we collect the data?

- Overall statistics via decadal review  
  (and within organisations – but generally private…)
- Membership of professional societies
- Government reporting (higher ed; ARC grants; CSIRO)
- Surveys (very difficult/time consuming!)

…true in Australia and internationally
(4) Some numbers….

- National Committee of Astronomy (NCA)
  - community stats via decal review data

- Astronomical Society of Australian (ASA)
  - membership, meeting and prizes data

- Australian Research Council (ARC)
  - grant success

- Federation of Australian Sci &Tech Societies (FASTS)
  [now Science & Technology Australia]

- CSIRO – Australia’s government science organisation

- Plus international:
  - IAU, USA (NSF, AAS, APS), UK, European Commission,…
National Committee of Astronomy (NCA) data

- Over decadal timescale (96 → 05) % women increasing:
  - 15% to 20% W academics
  - 20% to 41% W grad students
- But last 10 years (05 → 10 → 14) pretty flat:
  - 20% to 21.5% to 21% W academics
  - 41% to 40% to 29% W grad students
- Last decade > 30% increase in total number of astro position
  [with large increase in contracts: 37% → 48% → 65%]★

→ are more contracts worse for women?

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Staff (%W)</th>
<th>Total Students (% W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>417 (19.7%)</td>
<td>157 (41.4%)</td>
</tr>
<tr>
<td>2010</td>
<td>536 (21.5%)</td>
<td>237 (39.7%)</td>
</tr>
</tbody>
</table>
| 2014 | 390 (21%)        | 326 (29%)            | ★
Women in Astronomy
Chapter of the
Astronomical Society of Australia

Astronomical Society of Australia (ASA) data

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fellows</td>
<td>103 (13.6%)</td>
<td>105 (13.3%)</td>
<td>79 (12.7%)</td>
<td>77 (11.7%)</td>
<td>53 (3.8%)</td>
<td>59 (1.7%)</td>
</tr>
<tr>
<td>Honorary</td>
<td>16 (6.3%)</td>
<td>16 (6.3%)</td>
<td>16 (0%)</td>
<td>16 (0%)</td>
<td>15 (0%)</td>
<td>14 (0%)</td>
</tr>
<tr>
<td>Member</td>
<td>279 (24.0%)</td>
<td>243 (20.6%)</td>
<td>229 (19.7%)</td>
<td>204 (18.1%)</td>
<td>214 (16.4%)</td>
<td>260 (20.4%)</td>
</tr>
<tr>
<td>Associate</td>
<td>20 (25.0%)</td>
<td>19 (26.3%)</td>
<td>13 (15.4%)</td>
<td>10 (20%)</td>
<td>9 (22.2%)</td>
<td>10 (30%)</td>
</tr>
<tr>
<td>Student</td>
<td>228 (35.0%)</td>
<td>190 (37.4%)</td>
<td>153 (33.3%)</td>
<td>106 (46.2%)</td>
<td>84 (42.9%)</td>
<td>68 (39.7%)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>646 (26.0%)</td>
<td>573 (24.6%)</td>
<td>490 (22%)</td>
<td>413 (23.5%)</td>
<td>375 (20%)</td>
<td>411 (20.4%)</td>
</tr>
</tbody>
</table>

(Note that not all astronomers are members of the ASA!)
### Astronomical Society of Australia (ASA) data

<table>
<thead>
<tr>
<th>Prizes</th>
<th>Years</th>
<th>% Women</th>
<th>Awardees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bok prize</td>
<td>1989-2014</td>
<td>33%</td>
<td>Honours</td>
</tr>
<tr>
<td>Charlene Heisler prize</td>
<td>2006-2014</td>
<td>22%</td>
<td>PhD</td>
</tr>
<tr>
<td>Louise Webster prize</td>
<td>2009-2014</td>
<td>33%</td>
<td>Postdoc</td>
</tr>
<tr>
<td>David Allen prize *</td>
<td>2001-2012</td>
<td>0%</td>
<td>Outreach</td>
</tr>
<tr>
<td>Robert Ellery lectureship +</td>
<td>1991-2013</td>
<td>8%</td>
<td>Astronomy</td>
</tr>
<tr>
<td>Student poster prize #</td>
<td>2010-2014</td>
<td>67%</td>
<td>Students</td>
</tr>
<tr>
<td>Student talk prize #</td>
<td>2010-2014</td>
<td>55%</td>
<td>Students</td>
</tr>
</tbody>
</table>

* Only 4 David Allen prizes awarded to date
+ Robert Ellery awarded every 2 years
# First prize poster & talks: 4/5 women (80%)
# Women in Astronomy

## Chapter of the

Astronomical Society of Australia

<table>
<thead>
<tr>
<th>Year, Location</th>
<th>Participants</th>
<th>Invited speakers</th>
<th>Contributing speakers</th>
<th>Posters</th>
<th>SOC</th>
<th>LOC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009, U. Melb</td>
<td>222 (28%)</td>
<td>16 (19%)</td>
<td>42 (33%)</td>
<td>92 (69%)</td>
<td>7 (29%)</td>
<td>5 (60%)</td>
</tr>
<tr>
<td>2010, U. Tas</td>
<td>189 (26%)</td>
<td>12 (50%)</td>
<td>52 (29%)</td>
<td>86 (?)</td>
<td>6 (17%)</td>
<td>9 (45%)</td>
</tr>
<tr>
<td>2011, U. Adel</td>
<td>240 (25%)</td>
<td>16 (25%)</td>
<td>53 (32%)</td>
<td>133 (23%)</td>
<td>11 (27%)</td>
<td>8 (25%)</td>
</tr>
<tr>
<td>2012, UNSW</td>
<td>237 (30%)</td>
<td>13 (31%)</td>
<td>75 (28%)</td>
<td>102 (30%)</td>
<td>10 (50%)</td>
<td>11 (36%)</td>
</tr>
<tr>
<td>2013, Monash</td>
<td>275 (36%)</td>
<td>16 (50%)</td>
<td>86 (31%)</td>
<td>74 (33%)</td>
<td>9 (55%)</td>
<td>12 (25%)</td>
</tr>
</tbody>
</table>

(data only collected for past 5 years)

2014 ASA ASM data from Macquarie coming soon…!
Australian Research Council (ARC) DP success data

- Gender by career age of participants (bar) and success rates (points) for ARC-DP (2004-2009)

- Gender success rate of ECR-only ARC DP proposals (2001-2009)

(From 2010 ARC Discovery Project Consultation Paper)
# Australian Research Council (ARC) success data

<table>
<thead>
<tr>
<th>ARC DP</th>
<th>Participants (%W)</th>
<th>Success rate (W)</th>
<th>Success rate (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014 DPs</td>
<td>9951 (24.5%)</td>
<td>18.3%</td>
<td>20.0%</td>
</tr>
<tr>
<td>2013 funding</td>
<td>9309 (24.8%)</td>
<td>18.3%</td>
<td>21.6%</td>
</tr>
<tr>
<td>2011 fellowships</td>
<td>1389 (31.2%)</td>
<td>14.5%</td>
<td>13.6%</td>
</tr>
<tr>
<td>2011 ECRs</td>
<td>753 (33.5%)</td>
<td>15.1%</td>
<td>11.4%</td>
</tr>
<tr>
<td>2010 ARC grants</td>
<td>9700 (24.5%)</td>
<td>21.3%</td>
<td>25.3%</td>
</tr>
</tbody>
</table>

![Success rate by gender (2006-2013)](chart.png)

(ARC Discovery Project Selection Reports)
Women in Astronomy  
Chapter of the 
Astronomical Society of Australia  
(Science & Tech Australia)

Federation of Aust. Sci &Tech Societies (FASTS) data

2007 snapshot data clearly indicates:
• relatively high levels of participation at undergraduate and post-graduate levels achieved
• but persistently low levels of representation of women at senior levels of the academy

Australian academic profiles by gender in natural and physical sciences 2007
(DEEWR Selected Higher Education Student Statistics + DEST Special Report FTE Staff in AOU Groups 2007)

(From FASTS Report: Women in Science in Australia: Maximising Productivity, Diversity and Innovation, 2009)
CSIRO data

Summary of 2009 snapshot: CSIRO has few women, particularly in higher levels and in the physical sciences across all levels.
- 38.5% women in CSIRO
- 8% of level 8 are female (was 4.5% ten years ago)
- at this rate, will ~60 years for % of women at Level 8 to equal % of CSIRO women (i.e. 39%)

Percentage of CSIRO women by CSOF level, from 2009 Annual Report
CSIRO data

Summary of 2009 snapshot:
CSIRO has few women, particularly in higher levels and in the physical sciences across all levels.
- 38.5% women in CSIRO
- 8% of level 8 are female (was 4.5% ten years ago)
- at this rate, will ~60 years for % of women at Level 8 to equal % of CSIRO women (i.e. 39%)

(From Women in science at CSIRO, excerpt from 2009: FASTS Women in Science in Australia: Maximising Productivity, Diversity and Innovation report.)
CSIRO data

SMH: “Equity a distant prospect for women in CSIRO”
25 Aug 2014:

CSIRO’s latest 2013 annual report indicates:
- 40% CSIRO employees W
- 24% research scientists W
- 12% technical services roles W
- 11% research management W
- 76% admin staff W
USA data: students

Astro BA graduates more than doubled in 15 years, while % women pretty flat over past 10 years (~40%)

Astro women PhD doubled n past ten years. 2012 PhD graduates: 32% women

USA data: students

- Steady rise in % W astro BA until early 2000s, then relatively flat for last decade at 40% (cf. physics: 20% W graduates).
- Triple the % W astro PhDs in past 25 years; currently 32%

(From AIPS Statistics Research Centre, Astronomy Enrollments & Degrees, Mulvey & Nicholson 2014)
USA data: faculty

- % W physics faculty continues to rise (14% in 2010)
- % W in each academic rank continues to rise
- Largest rank (Prof) has fewest W (< 10%)

- % W astronomy faculty similar trends (rising, Profs lowest %)
- % W in astro generally 5% higher than physics (19% in 2010)

(AIP 2010 Physics Survey, Ivie et al. 2013)
**USA data: new jobs**

- % W newly hired continues to rise
- assistant prof, instructor, adjunct above rate of doctorates (18% 2007)

<table>
<thead>
<tr>
<th>Percentage of Newly-Hired Physics Faculty Who Are Women</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>by Academic Rank</td>
<td>2006</td>
</tr>
<tr>
<td>(%)</td>
<td>(%)</td>
</tr>
<tr>
<td>Full Professor                                         9</td>
<td>10</td>
</tr>
<tr>
<td>Associate Professor                                    8</td>
<td>20</td>
</tr>
<tr>
<td>Assistant Professor                                    25</td>
<td>22</td>
</tr>
<tr>
<td>Instructor / Adjunct                                   23</td>
<td>23</td>
</tr>
<tr>
<td>OVERALL                                                22</td>
<td>21</td>
</tr>
</tbody>
</table>

- 47% of BS/BA depts have no W
- < 10% PhD depts have no W
- BS/BA depts have fewer faculty, so higher proportion have no W
Women in Astronomy
Chapter of the
Astronomical Society of Australia

USA data: prizes

(From The Ongoing Demographic Shift in the AAS, STATUS, Jan 2009)

<table>
<thead>
<tr>
<th>Prize</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>As of 1990</td>
<td>Since 1991</td>
</tr>
<tr>
<td>Russell</td>
<td>41</td>
<td>11</td>
</tr>
<tr>
<td>Warner</td>
<td>38</td>
<td>17</td>
</tr>
<tr>
<td>Pierce</td>
<td>15</td>
<td>12</td>
</tr>
<tr>
<td>Tinsley</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Heinman</td>
<td>10</td>
<td>19</td>
</tr>
</tbody>
</table>

Table 1: Prizes of the AAS through 2008

<table>
<thead>
<tr>
<th>AAS Prizes</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>before 1990</td>
<td>93%</td>
<td>7%</td>
</tr>
<tr>
<td>since 1991</td>
<td>91%</td>
<td>9%</td>
</tr>
</tbody>
</table>

AAS members:
1973: 8%
1990: 12.6%
1995: 16.5%
**USA data: prizes**

- Women in life sci, phys, maths signif. less likely to receive scholarly awards cf. teaching awards
- Regardless of % women, men x2 as likely to win research award than women
- Women on prize committees help, but gender of chair most signif.
UK data

- 2003-2009: W physics rose: 13% → 16%
- % of W drops as academic rank increases:
  - 1 W Prof for every 10 W S. Lect.
  - 1 M Prof for every 3 M S. Lect.
- 2003-2009: physics PhD rose by 20%, while W PhD fixed at 22%
**European astro data**

France:
- CNRS: 26% women
- CNRS medals: gold 0%, silver 14%, bronze 25%
- French Academy of Science: 10% women

European Southern Observatory (2005):
- 18.7% women staff
- 3.4% women top level

UK astro women:
- 22% postdocs
- 10% lecturers
- 4% profs

(IAU Women in Astronomy, Catherine Cesasky, 2009)
International Astronomical Union (IAU) data

Latin America
- Argentina – 36% women
- Brazil – 22%
- Chile – 17%
- Mexico – 16%

Asia
- Japan – 5.8%
- China – 15%

- USA – 13% (N=2687, 25% of IAU)
- UK – 13%
- Canada – 13%
- Australia – 15%

IAU membership: 15% women

(IAU WG Women in Astronomy 2012)
International data: career + family

Compared to colleagues, how quickly have you progressed in your career?

- No kids: no gender effect
- ~30% women with kids progress more slowly
- ~37% men with kids progress more rapidly

(3rd IUPAP International Conference of Women in Physics, 2008. ~15,000 respondents from 130+ countries.)
### International data: career + family

**How did your work or career change because you are a parent?**

<table>
<thead>
<tr>
<th>Change in Work or Career</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>I chose a less demanding or more flexible work schedule</td>
<td>39</td>
<td>20</td>
</tr>
<tr>
<td>I changed my employer or field of employment</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>I spent significantly less time at work</td>
<td>35</td>
<td>18</td>
</tr>
<tr>
<td>I was more productive and efficient at work</td>
<td>29</td>
<td>15</td>
</tr>
<tr>
<td>My career or rate of promotion slowed significantly</td>
<td>34</td>
<td>9</td>
</tr>
<tr>
<td>I became a stay at home parent</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>My work or career did not change significantly</td>
<td>32</td>
<td>65</td>
</tr>
</tbody>
</table>

- 68% women’s careers affected by family (cf. 35% men)
- 35% W spend lots less time at work (cf. 18% M)
- 34% W career progress slowed (cf. 9% M)
- 29% W more productive (cf. 15% M)
(5) Plans for Future Data Collection

- NCA decadal plan demographics survey
  - Stay tuned!  
    [!! Can we collect summary data annually!]

- WiA Chapter collects ASA ASM statistics:
  - gender stats of participants, speakers, invited speakers, LOC/SOC

- Plus:
  - ASA prize winners (and student ASM prizes)
  - ASA council members
  - ASA membership