

Women in Canadian Astronomy: Fifteen Years of Hard Data

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Abstract

Achieving diversity within the Canadian astronomical community is of interest to individual scientists, academic departments, funding agencies, and society as a whole. However, until recently, there had been no coordinated effort to study the gender demographics of the Canadian astronomical community. In 2001, we gathered and presented such demographic information for the period from 1991-2000. The present work reports the results of our follow-up survey, conducted in 2006, which covers the period from 2000-2005. We find that the representation of women in Canadian astronomy has improved markedly over the last five years. We also find that the size of the Canadian astronomical community has grown substantially over the same period. The improving representation of women remains strongest at the lowest levels of academia, with smaller gains achieved at each stage of advancement. We find that women are being hired into faculty positions at a rate approximately consistent with their representation in the applicant pool.

1 Background

Five years ago, we presented the results from the first survey (“Survey 1” hereafter) of gender demographics within the Canadian astronomical community, tracing the relative representations of men and women through different academic levels during the years 1991-2000¹. We found that women were significantly underrepresented at all levels of Canadian astronomy during the period studied, but that the trend was toward greater equality. As in other countries, we found that the ratio of women to men is highest at the lowest levels of academia we studied (i.e., among graduate students) and declines steadily, reaching its minimum at the level of full professor. The responses to Survey 1 represented only approximately half the astronomy population in Canadian academia (by number), being most acutely affected by the lack of participation of three of the largest departments in the country.

¹Reid, M. .A., & Matthews, B. C. in the January 2005 edition of STATUS, the bi-annual newsletter of the American Astronomical Society’s Committee on the Status of Women in Astronomy

2 Introduction

This followup survey (“Survey 2” hereafter) has been conducted to trace the representation of women in the five-year period 2001-2005. Data were requested for a period of six years (2000-2005) to ensure continuity. Our goal was to achieve more complete statistics by increasing the degree of participation in the community. This is of greater importance as these data are among those requested of members of the Coalition for Canadian Astronomy by government officers in relation to the LRP. In addition to the data requested as part of Survey 1, we have requested the numbers of incoming graduate students in MSc and PhD programs each year. Over time, these data, when compared with the number of graduands, can be used to assess the overall level of attrition from graduate programs.

3 Description of the 2006 Survey

3.1 Participation

For Survey 2, we broadened our scope to include smaller departments in community colleges where physics programs exist. We invited a total of 57 institutions to participate in the survey and received responses from 30. The full list of institutions polled in both iterations of the survey is shown in Table 1. In the table, asterisks indicate incomplete or otherwise problematic responses. In most cases, after contacting institutions which had submitted problematic or no responses, we were able to obtain accurate data. However, there were a few exceptions. The Survey 2 data provided by Université de Montréal were largely incomplete and were therefore excluded entirely from our analysis. The University of Alberta did not submit demographic information about their postdoctoral fellows, but we have used the rest of their submission. The University of Waterloo submitted only the *changes* in the number of people in each category for each year, from which we cannot reconstruct the absolute numbers of people in each category, so we have excluded their submission from the analysis. Two major centres of astronomical research did not participate meaningfully in either iteration of the survey: Queen’s University and York University. However, we are happy to be able to add to the list of respondents several major institutions which did not participate in the first iteration of the survey.

The great majority of the institutions which did not respond to Survey 2 were small universities and colleges. It is likely that most of these did not respond because they employ no personnel whose primary activity is astronomy.

Table 1: Institutions Surveyed

Institution	Survey 1 (1991-2000)		Survey 2 (2000-2005)	
	Inv.	Rep.	Inv.	Rep.
Acadia University	N	-	Y	Y
Algoma University College	N	-	Y	N
Augustana University College	N	-	Y	Y
Bishop's University	N	-	Y	N
Brandon University	N	-	Y	Y
Brock University	N	-	Y	N
Canadian Institute of Theoretical Astrophysics	Y	Y	Y	Y
Capilano College	N	-	Y	N
Carleton University	N	-	Y	N
Concordia University	N	-	Y	Y
Dalhousie University	N	-	Y	N
École Polytechnique de Montréal	N	-	Y	N
Herzberg Institute of Astrophysics (Victoria)	Y	Y	Y	Y
Herzberg Institute of Astrophysics (Penticton)	N	-	Y	N
The King's University College	N	-	Y	N
Lakehead University	N	-	Y	N
Laurentian University	N	-	Y	N
McGill University	Y	Y	Y	Y
McMaster University	Y	Y	Y	Y
Memorial University of Newfoundland	Y	Y	Y	N
Mount Allison University	N	-	Y	Y
Queen's University	Y	N	Y	N
Redeemer University College	N	-	Y	N
Royal Military College of Canada	N	-	Y	Y
Ryerson Polytechnic University	N	-	Y	N
Simon Fraser University	N	-	Y	N
St. Francis Xavier University	N	-	Y	N
St. Mary's University	Y	Y	Y	N
Trent University	Y	Y	Y	Y
Trinity Western University	N	-	Y	N
Wilfrid Laurier University	N	-	Y	N
University of Alberta	Y	N	Y	Y*
University of British Columbia	Y	Y	Y	Y
University of Calgary	Y	Y	Y	Y
University College of Cape Breton	N	-	Y	Y
University College of the Fraser Valley	N	-	Y	Y
University of Guelph	Y	Y	Y	Y
Université Laval	Y	Y	Y	Y
University of Lethbridge	N	-	Y	Y
University of Manitoba	Y	Y	Y	Y
Université de Moncton	Y	N	Y	N
Université de Montréal	Y	Y	Y	Y*
University of New Brunswick	N	-	Y	Y
University of Northern British Columbia	N	-	Y	Y

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Table 1 – Continued

University of Ottawa	N	-	Y	Y
University of Prince Edward Island	N	-	Y	Y
University of Regina	Y	Y	Y	N
Université Sainte-Anne	N	-	Y	N
University of Saskatchewan	Y	Y	Y	N
University of Sherbrooke	N	-	Y	Y
University of Toronto	Y	N	Y	Y
University of Victoria	Y	N	Y	Y
University of Waterloo	Y	Y	Y	Y
University of Western Ontario	Y	Y	Y	Y
University of Windsor	N	-	Y	N
University of Winnipeg	N	-	Y	N
York University	Y	N	Y	N

3.2 Methodology of Survey 2

Survey submissions were gathered using a web-based form. Because it allowed for automated, real-time validation of survey data, this format ensured greater uniformity and accuracy in the survey responses than the paper version used in the previous iteration of the survey. We also hope that the development of an online version of the survey will make it easier to administer annually. This will address the primary complaint of non-respondents to Survey 1, which was the necessity of compiling information covering long time intervals.

Participating institutions were first asked to indicate whether they employed anyone in the following categories between 1 Jan 2000 and 31 Dec 2005: full professors, associate professors, assistant professors, postdoctoral fellows, and other staff, such as sessional lecturers, instrumentationalists, observatory staff, etc. Among the professors, there were separate categories for full-time and part-time positions. The data on part-time faculty are excluded from our results because there were only 2 data points (1 male and 1 female part-time associate professor). For each year, participating institutions were also questioned about the number of students entering MSc or PhD programs and about the number of degrees awarded to graduates of these programs.

After selecting the categories relevant to their institution, participants were asked to indicate the number of men and women in each position for each year. To address a failing of Survey 1, Survey 2 forced participants to distinguish between an entry of '0' in any category and a non-response. Only one complaint was received about the format of the survey (from the University of Waterloo, whose data were not included in the survey for the reason discussed in the previous section), and that complaint can be addressed with revisions to the explanatory text. In order to make it easier for institutions to participate, we hope to administer the survey in this online format annually from now on.

4 Results: Representation of Women Improving

The essential and most encouraging finding from this survey is that the proportional representation of women in Canadian astronomy has risen in all categories but one (postdoctoral fellows). However, the news is not entirely rosy. Among graduate students, women are well on the way to comprising 50% of the total. But among faculty, it appears that women are still being hired out of proportion to their representation among the available candidates. Table 2 shows the mean proportional representation of women at all levels of Canadian astronomy over three five-year intervals: 1991-1995, 1996-2000, and 2001-2005. The categories of entering MSc students, entering PhD students, and "other" were not included in Survey 1 and so do not appear for the interval 1991-2000. For the period covered exclusively by Survey 2 (2001-2005), we have supplied the percentage of women at all institutions participating in Survey 2 as well as their percentage representation at only those institutions which participated in both iterations of the survey. Figures 1-6 show the representation of women in each category as a function of time between 2000 and 2005, using all of the Survey 2 data.

The data from both Surveys 1 and 2 show that the proportional representation of women is highest at the lowest levels of the academic hierarchy. From 1991-1995, 14% of MSc degrees in astronomy and astrophysics were awarded to women and the percentage of women dropped nearly monotonically with increasing academic rank. The same trend is seen in the results of Survey 2: over the last five years, women earned 44% of MSc degrees in astronomy and astrophysics but made up only 4% of full professors. Encouragingly, however, there have been great leaps in the representation of women within each category. For example, comparing only the institutions participating in both survey iterations, the percentage of MSc degrees awarded to women rose from 14% in 1991-1995 to 48% in 2001-2005. At most levels of academia, the percentage of women in Canadian astronomy has doubled or better since 1991-1995. However, as shown in the right column of Table 2, not only does the percentage of women decline with each level in the hierarchy, the percentage *increase* in their representation also declines with seniority. Although women more than tripled their numbers among MSc students between 1991-1995 and 2001-2005, their representation among associate professors less than doubled. It is worth noting that the percentage improvement in the representation of women among full faculty cannot even be calculated because there were no female full professors reported in Survey 1.

How should we interpret the fact that the representation of women is improving faster at lower levels of academia? Unfortunately, the data in hand do not constitute a sociological study and can't tell us what social factors might be at work. A close look at the numbers shows that, although the total number of women in any job category is small, they are being retained in the system. For example, Survey 1 found that 2 PhD's were awarded to women between 1991 and 1995 and that there was 1 female assistant professor of astronomy. If both of these female PhD recipients stayed in academia and if each spent about 6 years as a postdoc before being hired into a faculty job, we should expect there

to be about 3 female assistant professors of astronomy in Canada by the year 2000. In fact we find that there were 4 female assistant professors of astronomy in Canada in the year 2000. Thus, we can conclude that, subject to a strong caveat about small number statistics, female PhD graduates are being retained in the system. The most recent data suggest that the trend of retaining female PhD graduates has continued to the present day. Between 2000 and 2005, there were approximately 4 women and 9 men hired into assistant professor positions. The equivalent numbers for associate professors are 4 women and 8 men. Hence, it appears that, as the representation of women in the candidate pool has increased, so to has the rate at which they are hired.

The recent increase in the representation of women among Canadian astronomy faculty is attributable, in part, to the University Faculty Award (UFA) program of the Natural Sciences and Engineering Research Council of Canada (NSERC). The mandate of the UFA program is “to enhance the recruitment, retention and early career progression of women and Aboriginal people in tenure-track faculty positions in the natural sciences and engineering, in Canadian universities, by providing opportunities for them to establish a strong research record”. Many of the recent hires of women into faculty positions have been through the UFA program. In future iterations of this survey, we will attempt to specifically track the number of hires made under this program to assess its effect. At present, we lack the data to comment authoritatively on the influence of the UFA program. We do, however, wish to point out that, contrary to the assertion commonly made in the lunch rooms and hallways of academia, the UFA program has not resulted in a particularly strong bias *against* male job candidates. Although there is evidence from our survey that women are being hired somewhat out of proportion to their representation in the pool of applicants, men still account for about 70% of new hires. Moreover, it is possible to interpret the mandate of the UFA program as specifically *intending* to facilitate the hiring of women in greater proportions than their representation in the candidate pool. Such a measure would seem to be temporarily necessary to ensure that gender parity is achieved.

A potentially troubling result emerges when we consider the situation among female graduate students in astronomy and astrophysics. As shown in Table 2, women are more likely than men to finish MSc degrees but they are less likely to finish PhD’s. During the interval 2000–2005, women made up 39% of entering MSc students and 44% of graduating MSc students. Conversely, women made up 34% of entering PhD students, but only 28% of PhD recipients. We caution the reader here that the small-number nature of these statistics makes the significance of this finding uncertain. However, we emphasize the importance of recognizing potentially adverse conditions which may affect women, rather than holding them accountable for the poor statistics afforded by the size of the Canadian astronomical community.

4.1 Strong Growth of the Canadian Astronomical Community

The data collected for Survey 2 show some interesting statistics beyond those related to gender. According to the data, the overall size of the Canadian astronomical community has grown substantially over the last five years. The total number of professors has swelled from 79 in 2000 to 103 in 2005. Impressively, the number of postdoctoral fellows has nearly doubled from 44 to 77 over the same interval. However, the number of graduate degrees granted has tripled, from 13 in 2000 to 36 in 2005.

5 Conclusions

This is the second of the two large multi-year surveys we have conducted of the Canadian astronomical community on behalf of the Canadian Astronomical Society. Over the 15 years of data, we find an improving trend in the fractional representation of women. The gains are smaller at each subsequent level of academic hierarchy. In addition, the very small number statistics of the Canadian community means that the hiring of one woman into an academic department can radically change the percentage of women. We therefore stress the importance of noting the absolute numbers of the population as well as the fractional changes.

The survey data demonstrate that the overall size of the Canadian astronomical community is increasing. Between 2000 and 2005, the number of graduate degrees awarded in astronomy at the participating institutions tripled from 13 in 2000 to 36 in 2005, the number of postdocs rose from 44 to 77, and the number of full-time faculty rose from 79 to 103. Thus, the number of candidates for faculty positions is increasing faster than the number of available positions.

We would like to emphasize that, again because of the small overall size of the Canadian astronomical community, participation in this ongoing survey by all institutions is essential. Particularly because the absolute numbers of women at many levels of academia are still so small, missing contributions from one or two institutions can have a significant effect on our interpretation of the results. Furthermore, we emphasize that the information gathered in this survey is of interest not only to the Canadian astronomical community itself. One of the goals of the Canadian Long Range Plan for astronomy was to increase the representation of women at all levels. Hence, those outside our community to whom we are accountable are actively interested in ensuring that we are achieving our goals. We intend to conduct this survey annually from now on, imposing a fixed term during which institutions will be requested to submit responses. Having made the process of participation as simple as possible, we very much hope for 100% participation in future surveys.

Table 2: Mean Percentage of Women in Canadian Astronomy

Category	1991–1995	1996–2000	2001–2005 ¹	$\frac{(2001--2005)}{(1991--1995)}$
Full Professor	0	0	4 (6)	NaN
Associate Professor	10	13	18 (16)	1.8
Assistant Professor	12	23	31 (30)	2.6
Postdoctoral Fellow	7	17	14 (14)	2
Other	n/a	n/a	13 (13)	–
PhD's Granted	9	14	28 (39)	3.1
Entering PhD Students	n/a	n/a	34 (34)	–
MSc's Granted	14	20	44 (48)	3.1
Entering MSc Students	n/a	n/a	39 (42)	–

¹ Figures in parentheses were calculated using only those institutions which participated in both Surveys 1 and 2.

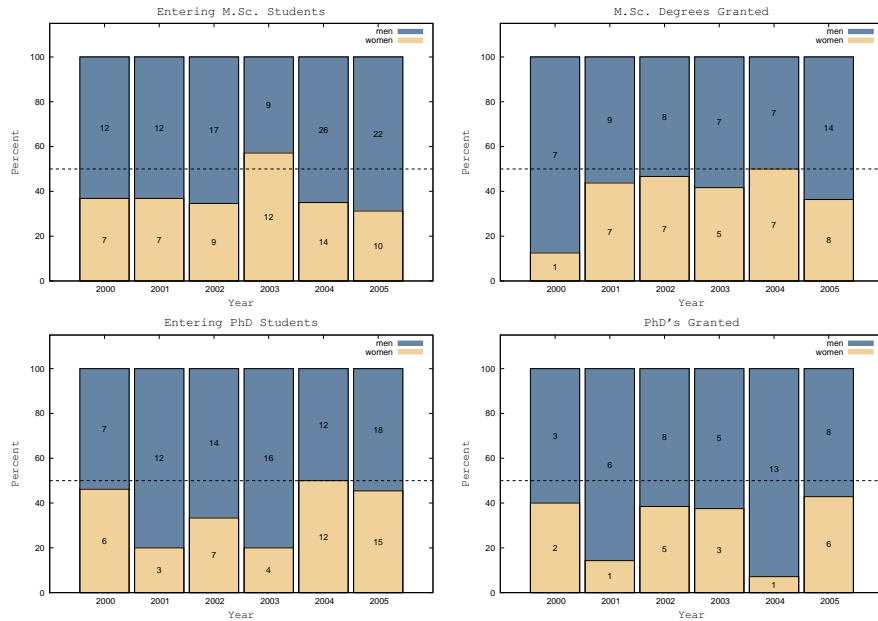


Figure 1: Gender distribution of students beginning and graduating from MSc and PhD programs in astronomy and astrophysics over the period 2000–2005. The number in each bar indicates the absolute number of people in that category. The dashed line indicates exact gender equality.

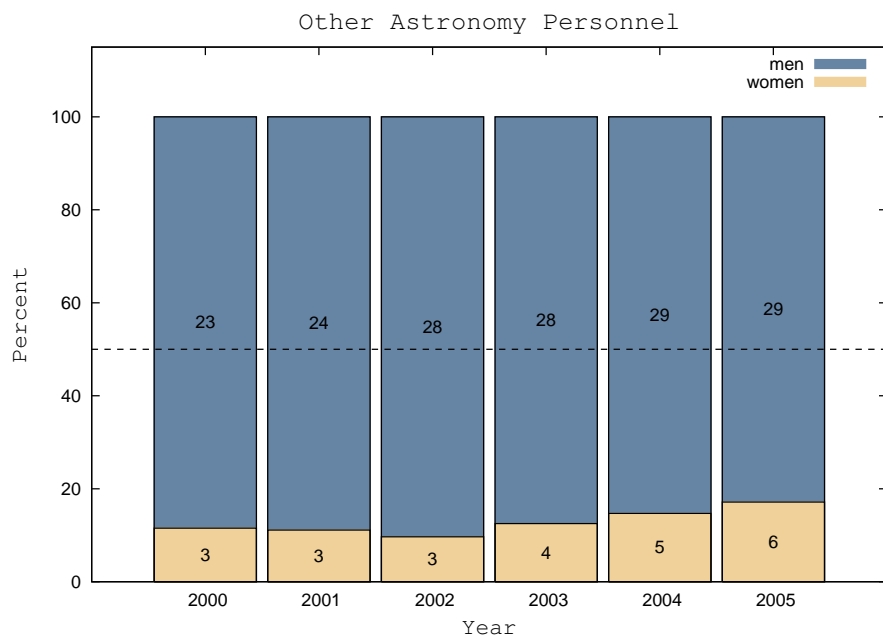


Figure 2: Gender distribution of employees in the "other" category, including sessional lecturers, instrumentationalists, observatory staff, etc. over the period 2000-2005. The number in each bar indicates the absolute number of people in that category. The dashed line indicates exact gender equality.

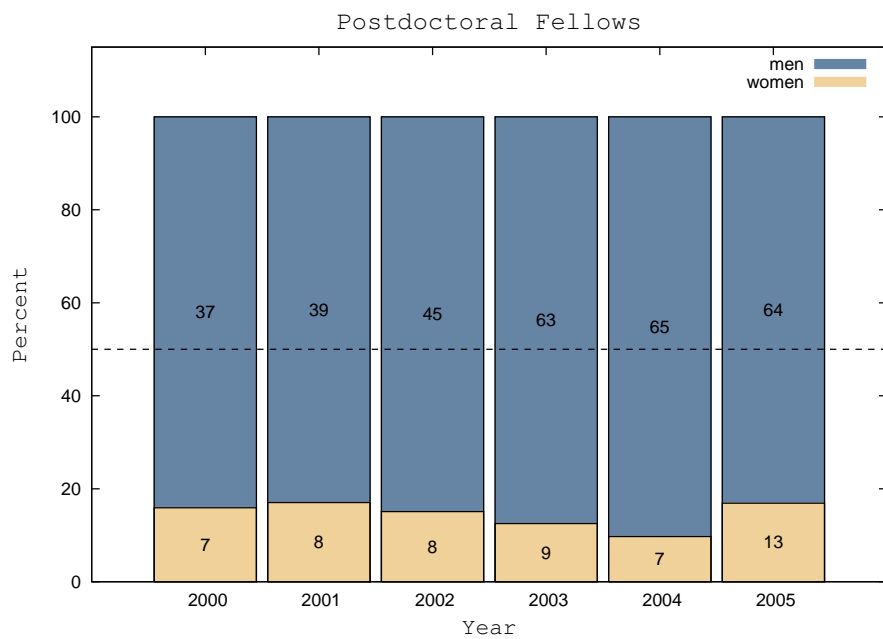


Figure 3: Gender distribution of postdoctoral fellows in astronomy and astrophysics over the period 2000-2005. The number in each bar indicates the absolute number of people in that category. The dashed line indicates exact gender equality.

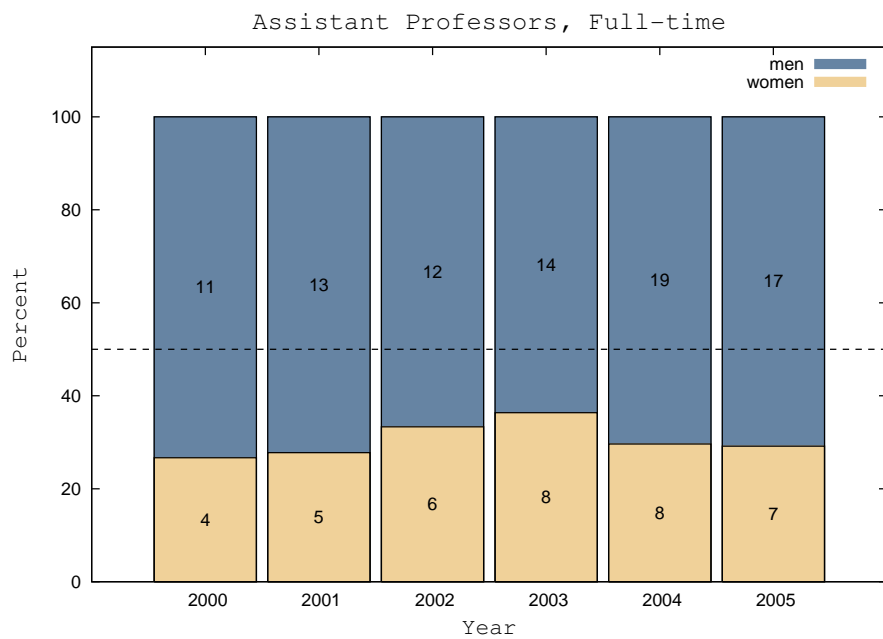


Figure 4: Gender distribution of assistant professors of astronomy and astrophysics over the period 2000-2005. The number in each bar indicates the absolute number of people in that category. The dashed line indicates exact gender equality.

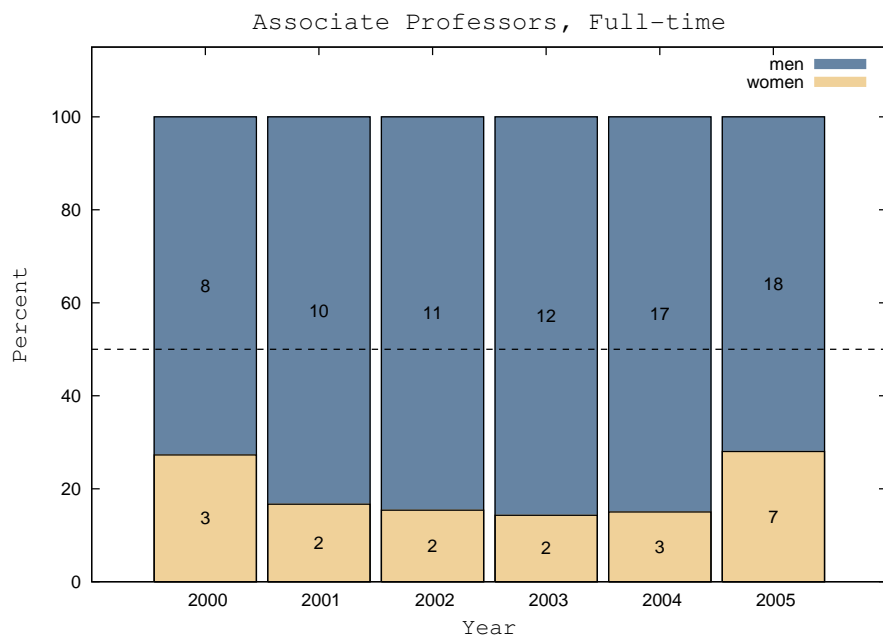


Figure 5: Gender distribution of associate professors of astronomy and astrophysics over the period 2000-2005. The number in each bar indicates the absolute number of people in that category. The dashed line indicates exact gender equality.

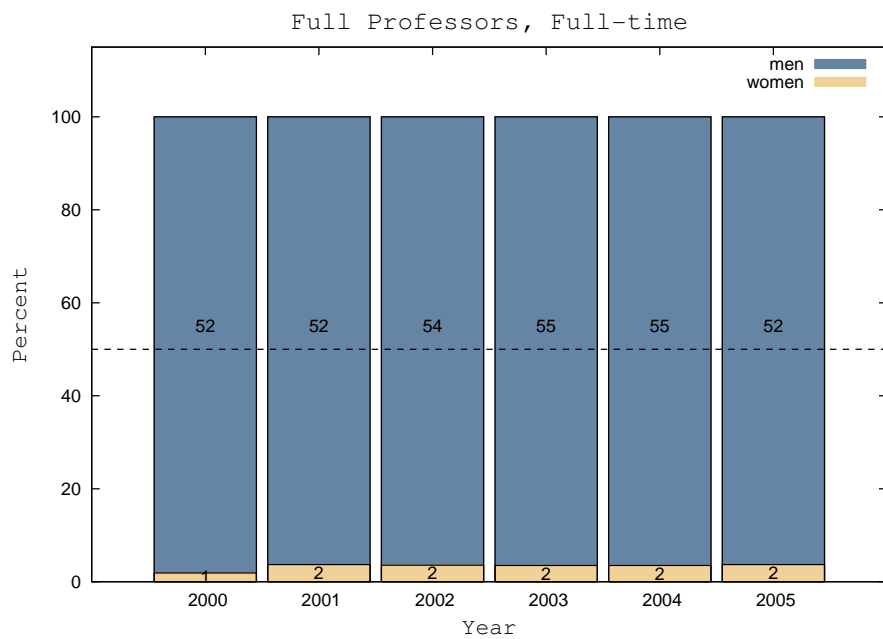


Figure 6: Gender distribution of full professors of astronomy and astrophysics over the period 2000-2005. The number in each bar indicates the absolute number of people in that category. The dashed line indicates exact gender equality.