Decadal Plan for Astronomy 2025-2034

Working Group 3.1: Demographics, Workforce & Society

Astronomical Society of Australia Annual General Meeting at Macquarie University, July 2023. Credit: Kateryna Andrych

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Working Group 3.1
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We kindly acknowledge the input of the Working Group 3.1 members who assisted with the design of the survey and checking of this report: Sven Buder, Celine D'Orgeville, Aditi Vijayan and Luca Casagrande.

Version 1.1 notes:

- *Added section Part 0 note to future co-chairs.*
- *Minor update to Table 5 and Figure 6 on postgrad applications and commencements.*
- *Figure numbers increment by 1 from Figure 9 onwards due to duplicate label figure number 8.*
- *Added Figure 13b on Disability and Neurodiversity as a function of Employment type.*
- *Change Table number 24 to 21.*

- *Added Appendix C data spreadsheets for Figures and Tables.*

Summary

Some key features of the demographic survey of the Australian astronomical community, compared with the decadal review in 2015, 2005 and 1995, are summarised in parts 2-5, following on from the introduction in part 1.

Part 2 Institutional Survey:

1. The total number of people working in Astronomy in Australia has continued to grow. The current decadal survey attempted to be as inclusive as possible, wording the survey to include everyone who 'works in Astronomy including support and technical staff', in addition to research astronomers, which was the focus of the 2014 census. Within that uncertainty, the numbers indicate that there are now 627 (including 184 continuing) positions, an increase of 62% from the 2014 total of 387 (139 continuing) positions in Australian Astronomy.

2. Measured against the 2014 census, including all support and technical staff - a substantial number who are employed at CSIRO - **the FTE in Astronomy increased 35% over the last decade. This is the most accurate measure of the growth.**

3. There has been significant shift in the overall fraction of women employees in Australian astronomy over the past decade. The percentage of women in fixed-term positions has increased from 22 to 34%, and in continuing positions, women have increased from 19 to 28%. The numbers represent a significant change from the two previous decades, which remained stubbornly low at ~20% across the non-student Astronomy research community in 2005 and again in 2015. **Measured over a decade, in the one career step, there appears no gender pipeline leak from 2014 fixed term (22% women) to 2024 continuing positions (28% women).**

4. In the last decade female-only positions have been introduced as one measure to increase gender balance. We examined recruitment method for continuing positions across 15 Universities in years 2019-2023. Over the 5-year reporting period 53% (16/30) of continuing hires were men. More men were appointed via non-advertised continuing positions (N=6) than women appointed via female-only advertised positions (N=4) and non-advertised (N=1) combined.

5. **A of total 304 students graduated with a PhD Astronomy/Astrophysics in 5 years period from 2019-2023.** The number of graduates is almost double that of ten years ago (N=159), outpacing FTE growth (35%, point 2 above), continuing a doubling trend from 2005 (N=83).

6. **The percentage of women PhD graduates** in the past 5 years (2019-2023) continues to decline and **is now 26.9%** - continuing a downward trend noted in the previous report - of a decline to 33.3% (2010-2014 graduates), down from 37.3% (2000-2004).

7. **Combining points (3) and (6) above, there is a large risk that the achievement of 28% women in continuing positions cannot be maintained into the future on the base of 26.8% women PhD graduates in the 2019-2023 cohort, a number that has been on the decline since its peak at the 2000-2004 cohort.**

8. Over the last 5 years, the growth in postgraduate student commencements has been driven by domestic students, more than doubling since the last decade. By contrast, international student enrolments in MSc and PhD degrees in Astronomy and Astrophysics declined by 30%. By 2023 international enrolments had recovered to pre-pandemic levels.

9. There is little difference in the gender representation of domestic (28.4% women) and international (29.8% women) PhD graduates across a detailed survey of 7 universities. Furthermore, recruitment method appears to have little bearing on the gender balance of PhD graduates from a survey of 14 universities.

Part 3 Individual Survey:

1. The individual Survey has captured about 50% of people working in Astronomy (N=557). The respondents are not evenly spread across the Astronomy workforce, and not everyone answered all question, for example, 73% of women (and 66% of men) in continuing positions responded to the Individual survey.

2. Compared with the Australian STEM career's pathway report (2024) LGBTIQA+ representation in the Australian Astronomy community (13%) is in line with participation in the broader STEM employment; postgrad students and fixed-term staff neurodiversity (13-16%) is 3-4 times higher than the broader STEM employment. Two percent of respondents are transgender, gender-fluid or intersex.

3. **Aboriginal and Torres Strait Islander Identity in the Astronomy Workforce (N=4/514) is significantly lower than both the Australian population and broader STEM workforce: approximately 20 indigenous people are expected, not 4.**

4. Compared with 2015 report, there has been an increase in the number of people working in Astronomy with primary citizenship of India and China. On primary cultural and ethnic ancestry, the percentage of European people increases from student (25%) to fixed-term (45%) through to continuing staff (64%), whereas the percentage of Asian people decreased from student (39%) to fixed-term (20%) through to ongoing staff (10%).

5. On primary role, the results show a drop in percentage of people working in pure research, meaning that the individual survey has either (i) been answered by people working in a wider range of roles in Astronomy, rather than pure research, or (ii) there has been a shift to a wider range of roles.

6. **As a technique, archival research is pursued by a quarter of the community (24.7%). Machine learning/Artificial Intelligence techniques are used by 17% of people working in Astronomy.** Compared with the 2014 survey, instrumentation as a whole has increased in research effort from 13% to 21%, overtaking Extragalactic astronomy as the most popular area of astronomy research. This change is likely due be point (5) above.

7. The distributions of primary cultural and ethnic ancestry for survey participants who are the first in their family to complete their highest degree are remarkably similar to all participants. This is interpreted as meaning that being the first in your family to complete a PhD in addition to having any particular ancestry/ethnic background is no additional barrier to be being employed in Astronomy in either a fixed-term or continuing position.

Part 4 Graduate Outcomes:

1. Seven institutions from six states or territories submitted information on PhD graduate employment outcomes. Data covering the first job after PhD completion exists for >90% of reported graduates, and for >80% four years after PhD completion. The sample can therefore be considered representative of the broader Australian astronomy PhD graduate cohort.

2. **60% of men and 71% of women graduates were working in academia one year after graduation, with 32% of men and 24% of women instead working in industry**, 6% of men and 5% of women in government employment, and 2% men and 0% women in teaching jobs. This represents **a slight shift away from academic employment compared to a decade earlier**: of graduates with reported outcomes in the 2016-2025 survey, 77% were in academia, 19% in industry and 3% in teaching.

3. **Those employed in academia were overwhelmingly in astronomy research positions, while those industry were primarily working in data science.** A small number of astronomy PhDs work in finance, natural resources, digital technology, not-for-profit and other industry sectors. Domestic and international students appear to have similar employment outcomes.

4. **The fraction of graduates employed outside academia is significantly higher than the 6% of students reported to have undertaken an internship during their**

PhD; 49% of students did not undertake an internship, and data was not available for the remaining 46%.

5. We examined the mobility of astronomy PhD graduates by comparing employment outcomes one and four years post-PhD. 15% of graduates changed their employment type, predominantly moving from astronomy research to data science.

6. Geographically, international graduates are (perhaps unsurprisingly) much more likely to move overseas after their PhD than domestic graduates. Women are more likely to move interstate than men for their first post-PhD job.

7. The number of Honours graduates over the five-year period 2019-2023 were very similar to a decade earlier (168 now vs 167 in the last Decadal Plan), suggesting that the Honours pipeline has stabilised. **Similar to a decade ago, the overwhelming majority of incoming Honours students in 2019-2023 (88%) were already studying at their host university**; only 10% came from another Australian university; and 1% from an international university.

8. Information about post-Honours careers was available for 75% of the students. **Mobility of Australian astronomy Honours graduates has increased: compared to a decade ago, the fraction of Honours graduates doing directly into employment has increased (12% of Honours graduates for whom data was available in 2014, compared to 20% in 2024)**, as has the fraction going on to further study at a different institution (13% a decade ago compared to 17% in 2024); these increases have come largely at the expense of continuing on to higher degree studies at the same university.

Part 5 Career Pathways:

1. The overwhelming majority of people working in astronomy as ongoing, fixed-term, or casual staff hold PhD qualifications.

2. Current postgraduate students report **astronomy and physics (over 40% each), followed by mathematics, computer science and engineering (14% total), as the most common degrees that lead to postgraduate studies in astronomy**. Many students reported degrees in multiple areas, suggesting double-majors or similar degree structure involving cognate disciplines.

3. **The number of fixed-term positions in Australian astronomy outnumber continuing positions by a factor of almost two**. This makes astronomy jobs less secure than all of STEM (66% permanent full time positions according to respondents of the STEM Career Pathways survey). This is consistent with jobs in the university sector and with PhD qualifications being less secure.

Commented [1]: what is this comment responding too?

4. **Length of fixed-term contracts in astronomy is broadly comparable with other areas of STEM in Australia**. More than half of respondents reported the duration of their contract as three years or more. 11% of fixed-term staff were employed on contracts which are shorter than 12 months. More than a third (37%) of fixed-term respondents working in Australian astronomy reported their previous position being outside Australia.

5. The fraction of men in senior positions in Australian astronomy is higher than expected from the total fraction of men in astronomy. However, men have older "academic ages" (as gauged from year of PhD). Comparing cohorts of similar academic age shows a much smaller gender bias: women appear to be slightly overrepresented at earliest career stages, but there is insufficient data to say whether this may be simply due to the larger fraction of women at the most junior academic ages.

6. **Respondents in ongoing positions were most likely to hold three (men) or two (women) fixed-term positions before landing a permanent role.** Women with carer responsibilities were the most likely to only take two postdocs before moving into a permanent position. However, these women were also the cohort with substantially more career disruptions (median total disruption 1.8 FTE) than the other cohorts (median 0.5 FTE), and they were significantly older academically (i.e. obtained their PhD earlier) than women in ongoing positions without carer responsibilities. Women with caring responsibilities may have more experience built up over a longer period than cohorts with fewer career interruptions.

7. Cohorts of North-West European and Oceanian-Australian backgrounds are disproportionately overrepresented in senior positions in Australian astronomy, while Southern and Eastern European and Asian cohorts are underrepresented. This result holds even when only Australian citizens (i.e. only those who have or are likely to stay in Australian astronomy long-term) are considered in the analysis. This is consistent with the broader underrepresentation of non-North West European cultural backgrounds in leadership positions in Australian society.

8. 16 astronomy **alumni provided insights into why they left astronomy. Overwhelmingly, these respondents identified poor career prospects, which was closely tied with lack of funding (identified as a major factor by over 90% of the respondents), and accommodating a partner's career (60%).** Financial reasons (30%) and parental responsibilities (20%) were the other nominated factors. Two thirds of the alumni respondents held fixed-term contracts as their last position in astronomy, with the remained casual or continuing contingent; they were overwhelmingly in entry-level or mid-career positions. These lived experiences are broadly consistent with self-identified potential barriers by those currently working in astronomy.

PART 0. NOTE TO FUTURE CO-CHAIRS

On reflection, there are several avenues to improve the efficiency of the survey and data analysis. In terms of gross numbers, the institutional survey is the underlying source of truth, thus its completeness is crucial. The survey was open for 3 weeks, and then on request, extensions were granted and data then sent in pdf or other forms. This led to large amount of data entry work. We recommend checking that the right person at the institute has acknowledged receipt of the survey and that responses from institutes are checked for completeness and followed up early in the process. Specifically, we recommended that the following modifications to the Institute survey:

- Avoid the use of text box when a numerical answer is sought.
- Specify that an employee or student should only be counted once (e.g. PhD student also working as a casual, count the substantive position only).
- Questions 6,7,9 and 10 on staff arrivals and departures were answered inconsistently, probably due to being too complex.
- CSIRO and other non-degree awarding institutes do not need to provide information on students.
- Request that CSIRO provide staff numbers working in research separate to support and technical staff.
- Question 11 on student graduation should be separated in PhD and MSc, domestic and international and gender.
- Question 12 on honours should ask about gender.
- Question 13 on current student numbers should be separated in PhD and MSc, domestic and international and gender.
- Question 14 and 15 were not used in this report.
- Question 16 should add gender.
- Funding and Growth questions (Q20-25) were not used in this report.
- Research Quality questions (Q26-31) were not used in this report.
- Instrumentation questions (Q32-42) were prepared and analysed by that WG.
- Industry Transition questions (Q43-60) were prepared and analysed by that WG.
- Outreach questions (Q61-76) were prepared and analysed by that WG.
- Education questions (Q77-103) were prepared and analysed by that WG.
- Indigenous questions (Q104-110) were prepared and analysed by that WG.

Detailed graduate outcome data was collected in a separate spreadsheet. The response rate was moderate with 7/15 Institutes responding to this request. Due to the collection method, the data was very clean and straightforward to analyse.

The individual survey was conducted over a period of 3 weeks and submitted by about 50% of Astronomy community. No question was compulsory, and responses dropped off with question number. Only 20 Alumni responded to the survey. We hope that this number will be greater next time by contacting alumni using the (optional) email address was supplied in question 90. Please note that some question numbers repeat due to branching of the

survey. Specifically, we recommended that the following Individual survey questions be modified:

- Avoid the use of text box when a numerical answer is sought.
- All demographic questions to be moved to the front of the survey (Q80 onwards).
- Question on employee type to be moved early in the survey (even if it needs to be asked again later for branched questions, e.g. 'If you answered 'student' to 'employee type').
- Ask the most important questions first.
- Nationality (Q4) only primary (not secondary or tertiary) was used in this report.
- Place of highest degree (Q17) not used in this report.
- Question 22, 24 & 25 should be presented such that percentages add to 100%.
- Questions 26-79 and 91-93 (Education & Outreach) were prepared and analysed by other WGs.
- Questions 80-83 should be designed to more easily capture career journeys in and out of academia and technical support roles.
- Questions 90 (Where were you previously based) and Q91 (Which continents have you worked on) were not used in this report.

The general comment section of the individual survey included some helpful suggestions for next time. These included: Adding a category for retirees, unemployed; adding LGBTQIA, disability and cultural identity to career barriers; not wording neurodiversity as a disability; consistent presentation of gender wording in the report; capturing non-academic-track careers paths such as research software engineering.

PART 1. INTRODUCTION

The Decadal Plan for Australia Astronomy, covering the period 2026-2035, will articulate a strategic vision for Australian astronomy and set a roadmap for addressing critical scientific questions and building the necessary infrastructure. To inform this document, the NCA's Demographics Working Group (WG3.1) conducted two extensive community surveys (see Appendices A and B) to collect and collate the information necessary to quantise and assess the total astronomy effort within Australia. The philosophy in designing the survey questions was to ask – at a minimum - all the same questions as the 2014 survey to provide a baseline to the previous decade. To maximize the response and reduce survey fatigue, all other working groups were invited to submit questions to both the individual and institutional survey.

The two surveys are summarised as follows:

1. The Institutional Survey was sent to each Australian institute involved in astronomy. The Institutional survey focused on staff numbers and movement, postgraduate student

details, institute funding and research quality, community and industry engagement, and education programs. In addition, institutes were asked to provide details of graduate employment outcomes at 1 and 4 years. The gross numbers and results from the Institutional survey are considered the most robust.

2. The Individual Survey was open to every person working in Australian astronomy and alumni, incorporating a number of questions covering personal demographics, research areas and techniques, and employment history. Compared with the 2014 census, this was anonymous and new demographic questions and options added on gender, cultural and ethnic ancestry, disability, sexuality and career influences. To facilitate future surveys of alumni, respondents were given the option of providing an email address for follow-up in 10 years. The full data was only available to Working Groups (WG) chairs with further anonymised data subsets distributed to relevant WG chairs. The individual Survey has captured ~55% of people working in Astronomy. The response bias is discussed in part 3.

PART 2. INSTITUTIONAL SURVEY RESULTS

2.1 Overall demographics

The total number of people recorded as working in Australian Astronomy, including support staff and students from Honours through to PhD is N=1119. The distribution of all people in Australian Astronomy is shown in Figure 1 distributed by both employment or student type (left) and Institution (right). In total 15 Universities plus CSIRO provided responses to the institute survey.

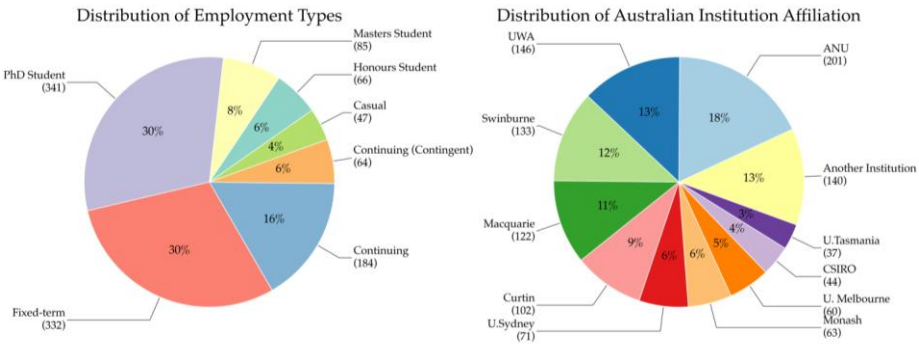


Figure 1: The distributions of the employment types (left) and the Australian institution affiliation (right) of people working in astronomy in Australia as reported in the institutional survey. The total number of people captured by the institute survey is N=1119.

The proportion of reported PhD students, fixed-term staff and continuing (including continuing contingent funding) are approximately equal. Over the last decade the mainstay of people in Astronomy has shifted somewhat with the largest 5 Universities changing from ANU, U. Sydney, UWA, Curtin and Swinburne (2014) to ANU, UWA, Swinburne, Macquarie and Curtin (2024).

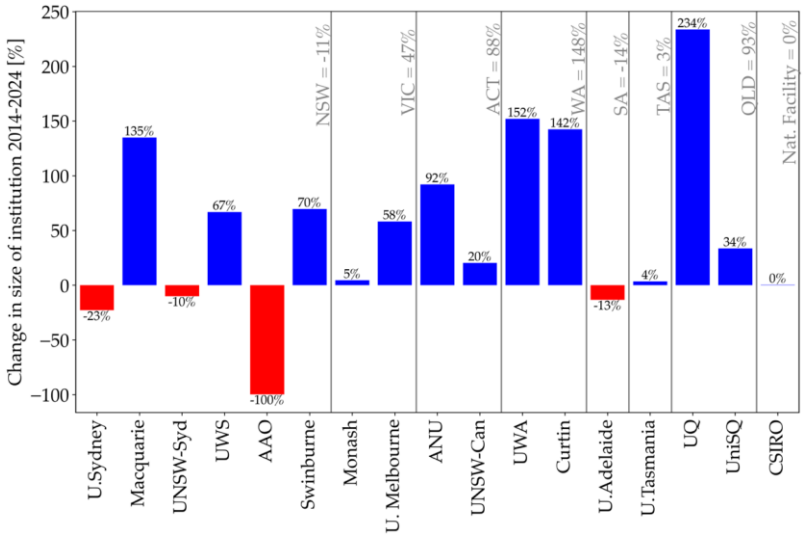


Figure 2: The percentage change in the size of each institute relative to itself 10 years ago. Size includes total count of all research, support and technical staff as well as master's and PhD students (Honours not included as per institute 2014 data is not available for comparison). Institutes are grouped by state with the percentage change indicated.

The percentage change in the overall size of each institute – measured by the total number of people in employed in Astronomy research, support and technical staff as well as master's and PhD students – is plotted in Figure 2. Four institutes have more than doubled in size: Universities of Queensland, Curtin, Western Australia and Macquarie. Conversely, the AAO no longer exists, and the Universities of Sydney, Adelaide and UNSW-Sydney have experienced slight declines in overall number. In terms of headcount the largest drivers of growth are ANU, UWA, Macquire, Curtin and Swinburne, with more than 50 additional people per institute over the last 10 years.

2.2 Staff demographics

2.2.1 Total staff

A total of 627 staff currently spent some portion of their time working in Astronomy at Australian institutions. Over half (N=332, 53%) are employed on fixed-term contracts, less than a third have permanent contracts (N=184, 29%). Smaller fractions of personnel are employed on Continuing Contingent Funding (CCF) contracts (N=64, 10%) and in casual positions (N=64, 7%). This is the first decadal plan that has surveyed CCF positions, which may have been counted in either fixed-term or continuing in the past. Casual staff were included in this decade's census, which may have been counted in fixed term positions in the past.

All Staff						Gender			
Institution	Fixed term	Continuing	CCF	Casual	**Total**	Women Fixed term (%)	Women Continuing (%)	Women CCF (%)	Women Casual (%)
CSIRO-all	54	143	0	20	**217**	18 (33%)	33 (23%)	0 (0%)	8 (40%)
CSIRO-research	21	23	0	0	**44**	6 (29%)	7 (30%)	0 (0%)	0 (0%)
Curtin	44	15	0	0	**59**	14 (32%)	4 (27%)	0 (0%)	0 (0%)
Macquarie	50	15	0	13	**78**	16 (32%)	4 (27%)	0 (0%)	4 (31%)
Monash	15	13	1	0	**29**	4 (27%)	2 (15%)	0 (0%)	0 (0%)
Swinburne	48	23	0	10	**81**	19 (40%)	6 (26%)	0 (0%)	5 (50%)
ANU	37	27	55	0	**119**	8 (22%)	7 (26%)	17 (31%)	0 (0%)
U Adelaide	3	3	0	1	**7**	2 (67%)	0 (0%)	0 (0%)	0 (0%)
U Melbourne	12	6	0	0	**18**	3 (25%)	2 (33%)	0 (0%)	0 (0%)
UQ	8	3	0	2	**13**	2 (25%)	2 (67%)	0 (0%)	1 (50%)
U Sydney	18	15	0	0	**33**	8 (44%)	6 (40%)	0 (0%)	0 (0%)
UWA	62	20	1	15	**98**	30 (48%)	5 (25%)	0 (0%)	10 (67%)
UniSQ	2	8	2	2	**14**	0 (0%)	1 (13%)	2 (100%)	0 (0%)
U Tasmania	7	4	1	3	**15**	0 (0%)	1 (25%)	1 (100%)	3 (100%)
UNSW Can	2	1	0	0	**3**	1 (50%)	0 (0%)	0 (0%)	0 (0%)
UNSW Syd	3	8	0	1	**12**	1 (33%)	4 (50%)	0 (0%)	1 (100%)
WSU	0	0	4	0	**4**	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Total	**332**	**184**	**64**	**47**	**627**	**114 (34%)**	**51 (28%)**	**20 (31%)**	**24 (51%)**

Table 1: Current staff in working in Astronomy at 16 reporting Australian Institutions, listed by contract type (Fixed term, Continuing, Continuing Contingent Funding (CCF), Casual) and percentage of women in each employment type. After consultation, ANU casuals have been adjusted on to reflect the main Astronomy occupation (e.g. PhD student recorded elsewhere in this survey). CSIRO-all (including support and technical staff are listed in grey for completeness). Only CSIRO research staff numbers (second row) are included in the totals on the bottom row.

All Staff FTE						Gender FTE			
Institution	Fixed term	Continuing	CCF	Casual	**Total**	Women Fixed term (%)	Women Continuing (%)	Women CCF (%)	Women Casual (%)
CSIRO-research	17.6	11.1	0	0	28.7	5 (28%)	3.4 (30%)	0 (0%)	0 (0%)
CSIRO-all	51.6	138.9	0	0	190.5	17 (33%)	30 (22%)	0 (0%)	0 (0%)
Curtin	43	15	0	0	58	13 (30%)	4 (26%)	0 (0%)	0 (0%)
Macquarie	48	15	0	12	75	16 (33%)	4 (26%)	0 (0%)	3 (25%)
Monash	15	13	1	0	29	4 (26%)	2 (15%)	0 (0%)	0 (0%)
Swinburne	39	22	0	3	64	18 (46%)	6 (27%)	0 (0%)	2 (66%)
ANU	35	27	51	0	113	8 (22%)	7 (25%)	14 (27%)	0 (0%)
U Adelaide	2	3	0	0	5	2 (100%)	0 (0%)	0 (0%)	0 (0%)
U Melbourne	10.9	6	0	0	16.9	0.9 (8%)	2 (33%)	0 (0%)	0 (0%)
UQ	8	3	0	1	12	2 (25%)	2 (66%)	0 (0%)	0 (0%)
U Sydney	18	15	0	0	33	8 (44%)	6 (40%)	0 (0%)	0 (0%)
UWA	52	19	1	0	72	25 (48%)	5 (26%)	0 (0%)	0 (0%)
UniSQ	8	2	2	2	14	1 (12%)	0 (0%)	2 (100%)	0 (0%)
U Tasmania	4	4	1	1	10	0 (0%)	1 (25%)	1 (100%)	1 (100%)
UNSW Can	2	1	0	0	3	1 (50%)	0 (0%)	0 (0%)	0 (0%)
UNSW Syd	3	8	0	1	12	1 (33%)	4 (50%)	0 (0%)	1 (100%)
WSU	0	0	4	0	4	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Total	**340**	**292**	**60**	**20**	**711**	**117 (34%)**	**63 (22%)**	**17 (28%)**	**7 (35%)**

Table 2: Current staff in working in Astronomy at 16 reporting Australian Institutions, listed by contract type (Fixed term, Continuing, Continuing Contingent Funding (CCF), Casual) and percentage of women in each employment type. CSIRO-research staff are listed in grey for completeness and comparison with Table 1. All CSIRO research staff numbers (second row) are included in the totals on the bottom row.

Estimating the change in total staff working in Astronomy over the last decades is not straightforward due to different methodologies. The current decadal survey attempted to be as inclusive as possible, wording the survey to include everyone who 'works in Astronomy including support and technical staff', in addition to research astronomers. The 2014 survey presented staff numbers for Astronomy research staff. In Figure 1 and Table 1 totals include CSIRO research staff only (second row). For completeness all CSIRO staff, including technical and support are listed in the top grey row. The numbers indicate that there are now 627 (including 184 continuing) positions, an increase from the 2014 total of 387 (139 continuing) positions in Australian Astronomy. Continuing contracts now account for 29% of positions compared with 36% a decade ago. We caution that this drop in fraction of the Astronomy workforce on permanent contracts may simply be due to including a broader range of the workforce in the census.

2.2.2 Full-time Equivalence

To estimate the change in total Astronomy FTE over the last decades we have attempted to include all the same type of staff as previous FTE counts. This means accounting for all CSIRO support staff, as indicated by CSIRO-all (second row) in Table 2, rather than just the research staff. The total FTE in Australian Astronomy has risen over the last decade to an FTE of 771. Measured against the 2014 census, the FTE has increased by 35%. The inclusion of CSIRO support and technical staff results in the estimated total FTE (711) being greater than the total number of staff given in Table 1 (N=628) which does not include this cohort. Over the last 30 years, the overall increase in FTE in Australian Astronomy is 67%. For context, the population of Australia has risen 50% from 1995 (18 million) to 2024 (27 million), meaning that the FTE effort in Australian Astronomy is approximately in line with respect to the population growth of the nation over the last 3 decades.

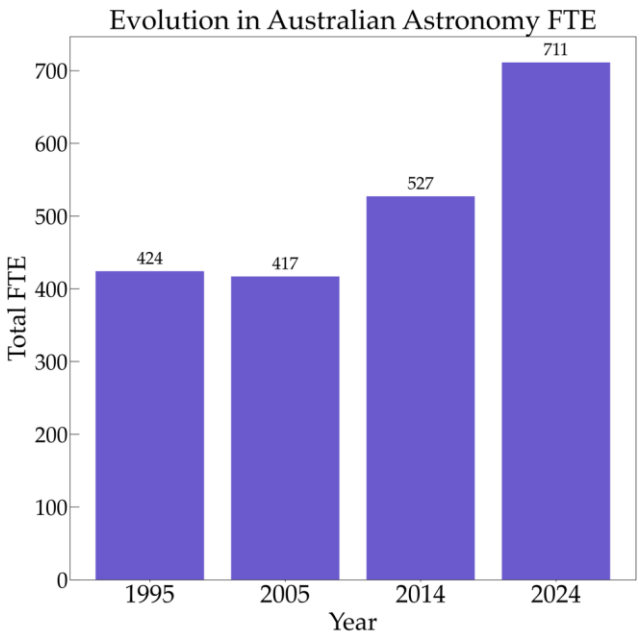


Figure 3: The evolution in Australian astronomy FTE over the last 4 decades. The 1995 & 2005 values include all research and support staff. The 2014 FTE includes research staff plus an estimated 242 FTE (64 and 178 technical and administrative support staff at the AAO and CSIRO, respectively). The 2024 FTE survey counts all research, technical and administrative support staff at both universities and CSIRO. Measured against the 2014 census, the current FTE has increased by 35%.

2.2.3 Staff Gender

One third of the workforce (N=209/627, 33%) are women. Staff with unknown or non-binary gender are included in the total number. Detailed gender demographics are self-identified in the individual survey. Table 1 gives the number of women reported in the institutional survey across the different employment types, with continuing (28%), CCF staff (31%), fixed-term (34%) and casual staff (51%) listed with percentage of women. The FTE-weighted percentage of women in each employment type are slightly different (Table 2), mostly due to the inclusion of CSIRO support staff in the FTE totals. Comparing 2024 'apples with apples', the FTE-weighted percentage of women is the same as non-weighted for continuing (28%) and fixed-term (34%) staff.

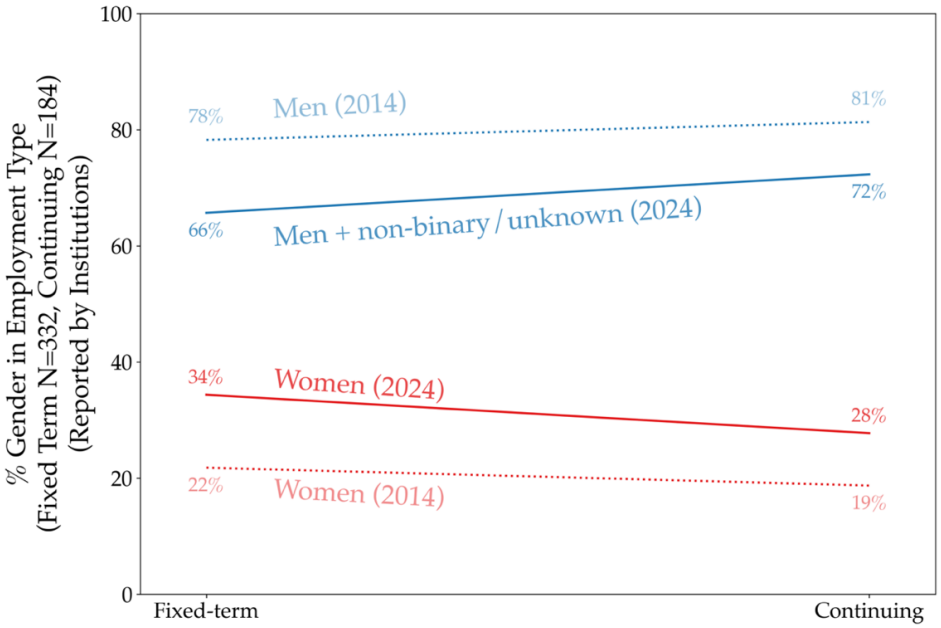


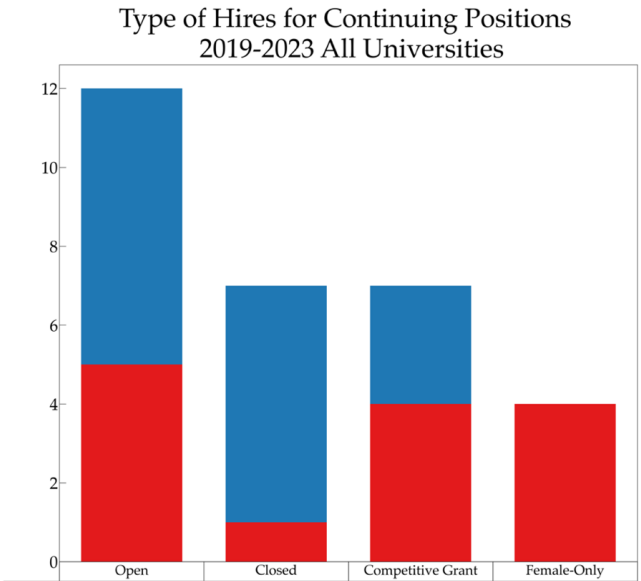
Figure 4: The percentage of women in Fixed-term and Continuing positions as reported by institutions. The evolution is shown from 2014 (light-coloured lines) to 2024 (solid-coloured lines). The plot shows an increase in percentage of women with time in both fixed-term and continuing positions. In 2014 gender was reported as men and women. In 2024 staff with unknown or non-binary gender are included in the total number. For detailed self-identified gender demographics please see the individual survey in Figure 9.

Two employment types, fixed term and continuing, can be compared directly with the previous decade. Figure 4 shows the evolution from 2014 (light-coloured lines) to 2024 (solid-coloured lines). The percentage of women in fixed-term positions in Astronomy has

increased from 22% to 34%, and the percentage of women in continuing positions in Astronomy has increased from 19 to 28%. The x-axis represents career progression from fixed term to continuing. Although the negative slope of the line shows a decrease in the fraction of women in permanent positions, with the passage of time, the 22% women in fixed-term positions in 2014 (N= 54) have 'become' the 28% in continuing positions in 2024 (N=51). Measured over a decade, in the one career step, there appears no gender pipeline leak on a population level from fixed term to continuing positions.

2.2.4 Recruitment method for Ongoing Appointments

The number of staff in continuing positions has grown by 45 in last 10 years, including a net gain of 26 women. We surveyed all University Astronomy departments on their hiring practices by asking the recruitment method for continuing positions in the 5 years 2019-2023. The results populated 4 categories (i) open advertised hire; (ii) closed strategic hire; (iii) position award on condition of a competitive grant, e.g. ARC Fellowship; and (iv) open advertised female-only hire. The results are presented in Figure 4. Over the 5-year reporting period 53% (16/30) of continuing hires were men. It is illuminating to note that more men were appointed via non-advertised continuing positions (N=6) than women appointed via female-only advertised positions (N=4) and non-advertised (N=1) combined.



	Open	Closed	Competitive Grant	Female-Only
Men	7	6	3	0
Women	5	1	4	4
Total	12	7	7	4

Figure 5: Distribution of hiring method for continuing positions in Australian Astronomy across 15 Universities in the 5-year period 2019-2023. Over the 5-year reporting period 53% (16/30) of continuing hires were men.

We examined whether hiring practice trends varied between universities. Each of the 15 reporting universities appointed 0-5 continuing positions each, no one category was dominated by a single university, and no one category was populated by more than 2 appointments per university. Exactly half of the appointments were made at Go8 and non-Go8 universities, respectively. All female-only continuing positions were advertised by Go8 Universities. The other three categories were split reasonably evenly between Go8 and non-Go8, with the distribution of women along the lines in figure 4.

2.3 Student demographics

2.3.1 PhD graduates – number and gender

The number of PhD graduates continues outpace the growth in Australian Astronomy FTE. Figure 6 shows that 304 students graduated with a PhD in 5 years period from 2019-2023. The number of graduates is almost double that of ten years ago (N=159).

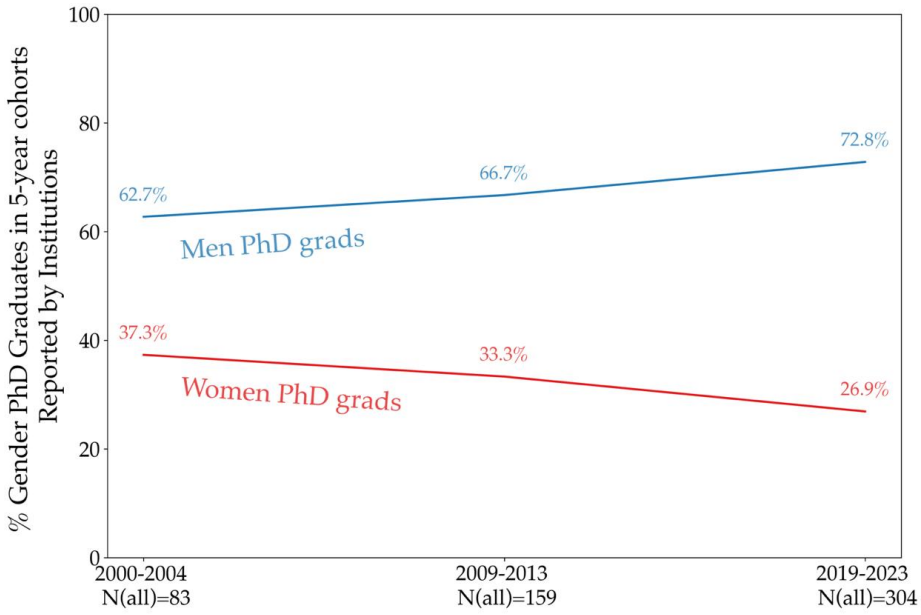


Figure 6: The percentage of Men and Women Astronomy/Astrophysics PhD graduates in 5-year cohorts over the last 3 decadal plan surveys. Gender was reported by the awarding University. The percentages in the latest cohort do not add exactly to 100% due to a small number of graduates

with non-binary/unknown gender. Self-identified student gender is reported in section 3. The total number of graduates has almost doubled each decade from 2004 to now.

The percentage of women PhD graduates has continued to decline each decade in the last three decadal plan surveys. In the 5-year period from 2019-2023, of the 304 students who graduated with a PhD in Astronomy/Astrophysics from an Australian University, only 26.9% were women. Ten years ago (2009-2013 cohort) this percentage was 33.3%, ten years before that (2000-2004) the percentage was 37.3%. The 2015 report noted 15% women PhD graduates in the 1995 census. The percentage of women graduates reported in this section is considered more robust than self-reported gender statistics in section 3, since a higher fraction of women answered the individual survey.

PhD Graduates in the past 5 years (2019-2023) – 15 Universities			
University	N(all)	women	percent
Curtin University	29	5	17%
Macquarie University	19	5	26%
Monash University	29	10	34%
Swinburne University of Technology	47	14	30%
The Australian National University	37	12	32%
The University of Adelaide	4	1	25%
The University of Melbourne	22	7	32%
The University of Queensland	10	1	10%
The University of Sydney	34	7	21%
The University of Western Australia	33	8	24%
University of Southern Queensland	10	3	30%
University of Tasmania	9	4	44%
UNSW Canberra	0		
UNSW Sydney	14	3	21%
Western Sydney University	8	2	25%
TOTAL	**305**	**82**	**26.9%**

Table 3: Number of students who have graduated with a PhD in Astronomy/Astrophysics in the past 5 years (2019-2023). Each row lists the University, total number of graduates, number of women graduates and percentage of women graduates.

To complement Figure 6, tabulated data for each University is presented in Table 3. The percentage of women graduates at individual universities varies from 10 % (University of Queensland) to 44% (University of Tasmania). Focusing on institutes with greater than 20 Astronomy/Astrophysics graduates, the fraction of women range from 17% (Curtin University) to 34% (Monash University). Tabulated data on gender of PhD graduates at each

Australian University is available in the 2025 Decadal plan (WG3.1 report table 4). The overall drop from 33.3% women graduates in 2010-2014 to 26.9% over the last 5 year has occurred across the country, although there are some variations on a university basis. The three largest graduators are the same in this and the previous decade (Swinburne, ANU and University of Sydney), and all three had higher fractions of women graduates last decade (39%, 35% and 35%, respectively) compared to the current cohort (30%, 32% and 21%). Western Australian Universities have experienced a large growth in PhD graduates, with Curtin and UWA graduating 3 and 4 students (including 2 women, state average 29% women) in 2009-2013, compared with 29 and 33 (including 13 women, state average 21%) in 2019-2023. The rapid growth in overall graduates in Western Australian Universities has not been matched in women graduates.

2.3.2 PhD graduates – gender, international and recruitment method

We surveyed the Universities on their recruitment method for domestic and international students. From the 14 responses were we able to split the Universities into two clean groups: those that allocated both domestic and international PhD scholarships on grades and research experience only (N=5 Universities, graduates =100) and those that allocated PhD scholarships on academic grades, research experience and other considerations, for example diversity, opportunity for an interview (N=7 Universities, graduates=146). The percentage of women graduates in the first and second cohort is 26.0% and 25.3%, respectively. Thus, the recruitment method appears to have little bearing on the gender balance of PhD graduates.

We examined the graduate outcomes data to explore possible reasons for the drop in the percentage of women PhD graduates. Detailed graduate outcomes data was supplied for 7 Universities (Monash, Swinburne, ANU, UQ, UWA, UTas, UNSW Sydney), which cover 179 graduates, i.e, over half of the total graduates presented in Table 3 and represent at least one university in each state except South Australia. Table 4 presents the aggregate number of graduates from the subset of 7 universities each year from 2019 to 2023. The percentage of women and international graduates (all genders) are provided. In this subset the overall percentage of women is only slightly higher (29.1%) than the national fraction, and thus provide a useful comparison.

In 2020 only one woman graduated with a PhD in Astronomy/Astrophysics out of 26 completions across a representative sample of 7 Universities (see Table 4). The COVID-19 pandemic has been attributed to a gendered impact on Astronomy publications (Böhm & Lui 2023, Nat. Astronomy https://www.nature.com/articles/s41550-022-01830-9). To explore this further detailed data on gender, PhD completion times and non-completion rates would need to be examined, which were not collected as part of this survey. There is little difference between the gender representation in domestic (28.4%) and international (29.8% women) PhD graduates across the 7 universities.

Approximately equal proportions of International (47%) and Domestic (53%) students graduated with a PhD in Astronomy/Astrophysics in the last 5 years in this subset of 7 Universities (see Table 4). The number of international and domestic postgraduate (MSc and PhD) student commencements were collected from 13 Universities in the main Institutional survey and can be compared directly with the 2015 report. This is explored in the next section.

PhD Graduate Demographics for a subset of 7 Universities							
Year	N(all)	women	% women	international (all genders)	% international	women international	% women international
2019	27	10	37%	9	33%	2	22%
2020	26	1	4%	14	54%	1	7%
2021	41	14	34%	19	46%	9	47%
2022	38	14	37%	22	58%	9	41%
2023	47	13	28%	20	43%	4	20%
Total	**179**	**52**	**29.1%**	**84**	**46.9%**	**25**	**29.8%**

Table 4: PhD Graduate demographics in a subset of 7 Universities (Monash, Swinburne, ANU, UQ, UWA, UTas, UNSW Sydney). PhD graduate numbers by year with number and percentage of women and international student graduates, respectively. The final column gives the percentage of international women out of the number of international graduates in that year.

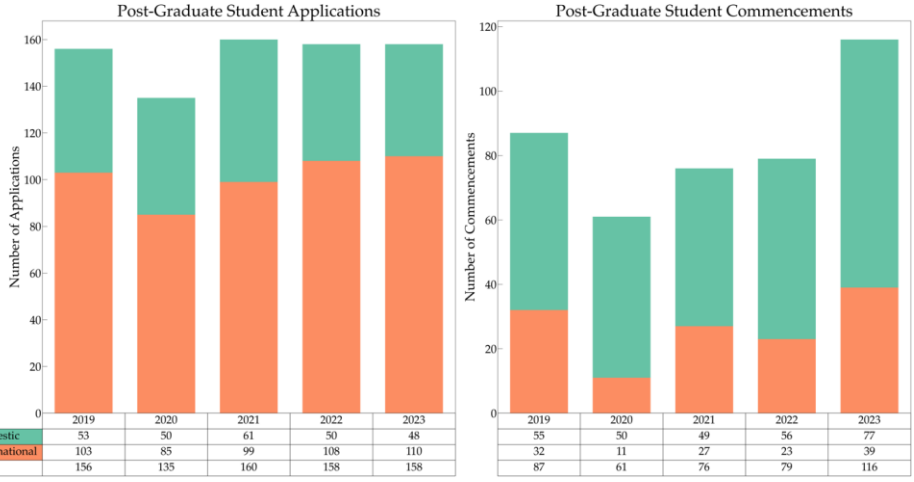
2.3.3 Postgraduate applications and commencements

The raw number of domestic and international postgrad (i.e. MSc and PhD) student applications and commencements were collected for the 2015 report over the 5-year period from 2009-2013. This corresponds to an increase in applications of greater than 100%, and a greater than 38% increase in commencements over the decade to the current census period of 2019-2023 as detailed in Table 5.

Post-Graduate Student Applications	2009-2013 total	2019-2023 total	% change
Domestic	180	262	46
International	204	505	148
Total	384	767	100
Post-Graduate Student Commencements	2009-2013 total	2019-2023 total	% change
Domestic	140	287	105
International	202	132	-35
Total	342	419	23

Table 5: Postgraduate student application and commencement number from the 5-year reporting period 2009-2013 compared with 2019-2023. The 2019-2023 application numbers are from 12 Universities (missing Macquarie, Melbourne and Monash). The 2019-2023 commencement numbers are from 13 Universities (missing Melbourne and Monash).

Over the last ten years the growth in postgraduate student commencements has been driven by domestic students, more than doubling over that period. By contrast, international student enrolments in MSc and PhD degrees in Astronomy and Astrophysics have declined by 30%. International commencements averaged 40 (N=202/5) per year in the previous reporting period and appeared to be maintained at that level in 2019. Figure 7 breaks down the current numbers into a year-by-year comparison. Evidently the COVID-19 pandemic caused a significant drop in international enrolments in 2020, recovering to pre-pandemic levels by 2023.



	2019	2020	2021	2022	2023
Domestic	53	50	61	50	48
International	103	85	99	108	110
Total	156	135	160	158	158

	2019	2020	2021	2022	2023
	55	50	49	56	77
	32	11	27	23	39
	87	61	76	79	116

Figure 7: The minimum number of domestic and international postgraduate (MSc and PhD) student applications (left) and the minimum number of domestic and international post-graduate student commencements (right) over the previous 5 years for 12 and 13 reporting Universities, respectively (as described in Table 5). If a university provided a range of applications/commencements in a year, the lower value of the range was used. We suspect that this data is not highly accurate, for example, one University reports 5 domestic applications and 25 commencements in 2023.

PART 3. INDIVIDUAL SURVEY RESULTS

557 responses were received for the individual survey, corresponding to approximately 50% of the 1119 people reported as working in Australian astronomy by the institutional survey. It is important to briefly compare response rates between different cohorts in the two samples before analysing the individual survey data.

The majority of respondents (448 of 557, 79%) indicated their employment type. All but one of these also reported their gender. By contrast, of the 119 respondents who did not provide information on their employment type, more than a quarter (33 respondents) also did not report their gender.

There was a high response rate of 70% by continuing and continuing contingent staff, with 174 responses from 248 staff reported by institutions. Women were proportionally represented in the individual responses, making up 30%, comparable to the 28% (continuing) and 31% (continuing contingent) of positions reported by institutions.

Fixed-term employee response rates were lower at only 41%, with 136 of a possible 332 respondents completing the survey. Women were overrepresented in this cohort, with 40% of responses despite only making up 34% of fixed-term employees reported by institutions. We received 95 responses from postgraduate students. The percentage of women respondents (38%) was higher than reported for this cohort by institutions (28%). Overall, women in continuing positions are proportionally represented, and those in fixed-term and postgraduate positions overrepresented in the individual survey. This should be kept in mind in the analysis below.

3.1 Institution Affiliation and Employment type

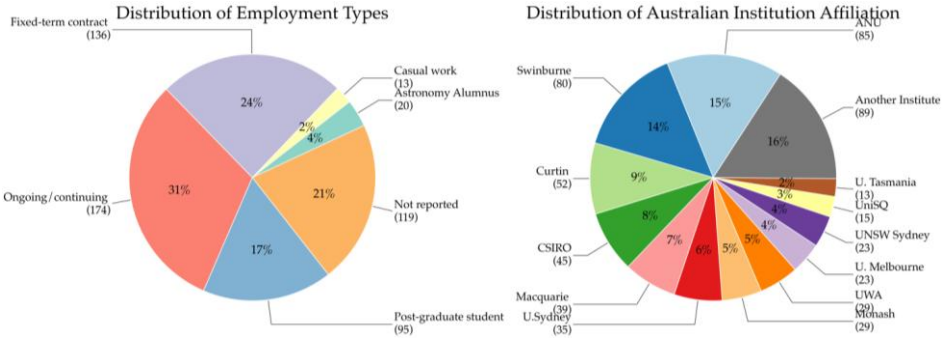


Figure 8: The distributions of the employment types (left) and the Australian institution affiliation (right) of people working in astronomy in Australia as self-reported in the Individual survey. The total number of people captured by the individual survey is N=557. The distribution of participants in the survey is not the same as the underlying distribution measured by the Institute survey shown in Figure 1.

Figure 8 shows the distribution of participants in the Individual Survey (N=557). All questions in the survey were non-compulsory and employment type had a relatively large fraction of non-responses. Institution affiliations included in the 'another' category on the pie chart listed in order of number of respondents (**Alumnus, Astronomy Australia Limited**, University of Queensland, UNSW-Canberra, **Working at a non-Australian Institution, Working at another Australian Institution, Manly Astrophysics, Department of Industry, University of Newcastle, Deakin**), with bold font indicating affiliations not covered by the institute survey.

The total number of people recorded as working in Australian Astronomy, including support staff, and students from Honours through to PhD is N=1119. The total number of respondents to the individual survey was N=557. Removing Honours and Master students from the Institutional survey results in N=968. Removing Alumni employment type from the Individual Survey results in N=537. Thus, the individual Survey has captured ~55% of people working in Astronomy. This estimate does not account for the 27 people who work at other institutes not captured by the 16-institute survey. Furthermore, not everyone answered every question (e.g. N=433 answered both gender and employment type). We note that the Individual Survey is biased, for example, 73% of women (and 65% of men) in continuing positions at the top 15 institutes responded to the survey.

3.2 Community demographics - centres and consortia

Survey participants were asked to indicate they were also a member of listed centre and/or consortia. The results are given in Table 8. A high fraction of the Australian community is involved in research centres/consortia, with 450 individual responses. Some of these responses will be people involved in more than one organisation; these crossmatches are summarized in Table 9. There is a large overlap between OzGrav and OzGrav 2, otherwise most dual affiliations are in single digits.

Affiliation	(Short)	Responders
Astralis Instrumentation Consortium	Astralis	36
International Center for Radio Astronomy Research	ICRAR	70
ARC Centre of Excellence for All-Sky Astrophysics in 3 Dimensions (commenced 2017)	ASTRO3D	134
ARC Centre of Excellence for Gravitational Wave Discovery (commenced 2017)	OzGrav	85
ARC Centre of Excellence for Gravitational Wave Discovery (commenced 2024)	OzGrav 2	89
ARC Centre of Excellence for Dark Matter Particle Physics (commenced 2020)	CDM	13
ARC Centre of Excellence in Optical Microcombs (commenced 2024)	COMBS	1
Astronomy Data and Computing Services	ADACS	22
Total		**450**

Table 6: Membership of listed centres/consortia for survey participants.

	None	Astralis	ICRAR	ASTRO3D	OzGrav	OzGrav2	CDM	COMBS	ADACS
Astralis	25		0	9	0	1	0	0	3
ICRAR	52	0		15	3	1	1	0	0
ASTRO3D	100	9	15		4	5	6	0	1

OzGrav	11	0	3	4		70	1	0	6
OzGrav 2	17	1	1	5	70		1	0	5
CDM	6	0	1	6	1	1		0	0
COMBS	1	0	0	0	0	0	0		0
ADACS	13	3	0	1	6	5	0	0	

Table 7: The table of Affiliations with other affiliations. From top to bottom: Astralis, International Center for Radio Astronomy Research (ICRAR), CoE ASTRO 3D, CoE OzGrav (commenced 2017), CoE OzGrav 2 (commenced 2024), ARC Centre of Excellence for Dark Matter Particle Physics, ARC Centre of Excellence in Optical Microcombs and Astronomy Data and Computing Services (ADACS).

3.3 Self-reported gender and sexuality

The anonymous individual survey asked three questions on gender and sexuality to provide a more accurate account of personal identity. To develop the wording of these questions we consulted the Victoria Government Guide to LGBTIQA+ inclusive language. Self-reported demographics will not be as complete and will not provide an even sample of the Institutional survey, however the answers to the individual questions will be more accurate. It is important to collect and report the demographics to understand if the Astronomy demographics reflect the wider Australian community. The three questions were gender identification; whether publicly out or not, are you transgender, gender-fluid, intersex? and sexual orientation. The results are present in Table 1. As noted above, 35% of respondents identify as a woman, which is more than all staff (33% women) and PhD graduates (27% women) in the institutional survey. Response rates to these questions were high (N>500) as the questions appear early in the survey. Percentage responses add to more than 100% when 'tick all that apply' was an option.

Gender identification (tick all that apply)					
Woman	Man	Non-binary	Self describe & other	Prefer not to say	Total responses
35%	60%	2%	<1%	3%	523
Whether publicly out or not, are you transgender, gender-fluid, intersex?					
Yes	No			Prefer not to say	Total responses

2%	94%	4%		508
Sexual Orientation (tick all that apply)				
Lesbian, Gay or Bisexual	Heterosexual or straight	Self describe & Other	Prefer not to say	Total responses
13%	77%	2%	9%	510

Table 8: Gender and Sexual Orientation responses to the Individual survey.

The Australian STEM career's pathway report (2024) find that 13% identified as LGBTQIA+, meaning that the LGBTIQA+ representation in the Australian Astronomy community is in line with the participation in the broader STEM employment.

3.3 Gender and employment type

The next table reports gender breakdowns for the employment types of Astronomy Alumnus, Casual work, Fixed-term contract, Ongoing/continuing contract, postgraduate student and non-reported.

	Number	Gender						
Category	All	Woman	Man	Non-binary	Self Describe	Prefer not to say	Other	Not reported
Astronomy Alumnus	20	6	14	0	0	0	0	0
Casual work	13	4	8	0	0	1	0	0
Fixed-term contract	136	55	74	2	0	4	1	1
Ongoing/continuing	174	52	117	1	0	5	0	0
Post-graduate student	95	36	58	1	0	1	0	0
Not reported	119	32	45	6	0	4	0	33
Total	**557**	**185**	**316**	**10**	**0**	**15**	**1**	**34**

Table 9: Distribution of gender in employment types. The sum of genders in each category don't necessarily match the 'All' number in column 2 since more than one answer may have been given.

The distribution of self-identified gender is plotted in Figure 8 (left), with the solid lines for Man, Woman and non-binary. The percentage of women in fixed term (40%) and continuing positions (30%) is 3-7 points higher than reported by the more complete Institute survey (34 and 28%, respectively). The percentage of women student (all student types who responded to the survey) is 38%, which is significantly higher than the institute-reported 27% women PhD graduates in the last 5 years (see Figure 6). For comparison, the gender statistics are plotted from the 2014 survey, which reported self-identified binary gender; and the 2004 survey institute-identified gender. A similar trend is noted, with a higher proportion of women than men answering the individual 2014 survey, increasing the women percentage by 2-3 points across the employment categories. Overall the gender

percentages in fixed-term and ongoing employment of the individual survey follow the same trends as seen in the Institutional survey.

There are a number of possible reasons why the percentage of women postgraduate students (38%) in the individual survey is significantly higher than the institute-reported 27% women PhD graduates in the last 5 years. A greater proportion of women than men answered the individual survey; Masters students may have answered the survey; the gender balance of the current cohort of student may be different to the 2019-2023 PhD graduates.

3.3.1 Gender and ASTRO 3D Affiliation

The ARC Centre of Excellence for All Sky Astrophysics (ASTRO 3D) commenced in 2017 with 37% members identifying as women and increased to 50% women, across all levels, including students through to Chief Investigators by June 2022 (Kewley et al. 2023), and concludes in 2024. At its peak ASTRO 3D had about 300 members working in Australian Astronomy; thus it is interesting to measure its impact on the whole Australian community. In Figure 8 (right) respondents to the individual survey were divided into two groups, ASTRO 3D (N=112), and non-ASTRO 3D. The surveyed ASTRO 3D members who answer both gender and employment questions (N=112/407) account for some but not all the increase in the representation of women. This indicates that the community has a whole has increased the number of women in all employment types, not just within the ASTRO 3D Centre of Excellence.

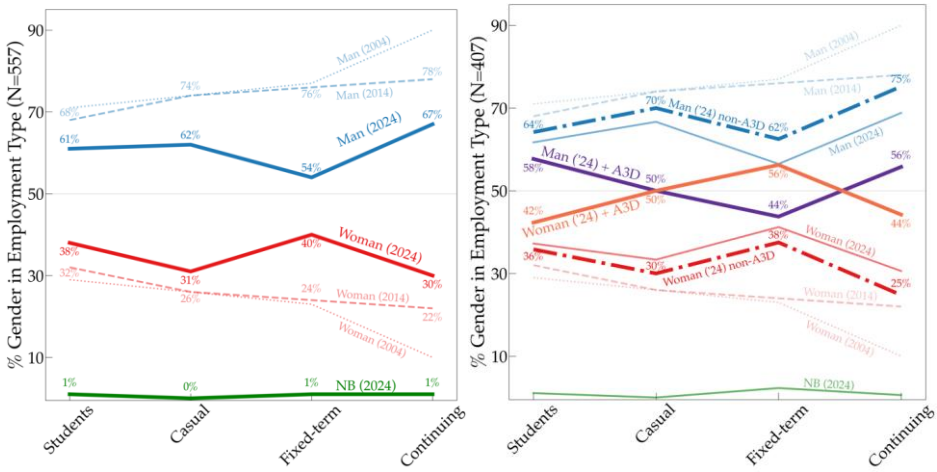


Figure 9 Left: The distribution of self-identified gender (blue, red and green for man, woman and non-binary, respectively within employment types (students, casual, fixed-term and continuing) and its evolution over the last 20 years. The 2014 individual survey reported self-identified binary gender (N=467); the 2004 survey reported institute identified gender. Right: A comparison between

the left distributions and two subsets of the 2024 responders: those with an ASTRO 3D affiliation (N=112, students=26, casual=2, fixed-term=32, continuing=52) (orange/purple solid lines) and those not affiliated with ASTRO 3D (red/blue dot-dashed lines). These individual survey results should read together with the complete institutional numbers in Figures 4 and 6.

3.3 Aboriginal and Torres Strait Islander Identity

Aboriginal knowledge of Astronomy holds a unique place in the cultural heritage of Australian Astronomy. There are precious few Aboriginal astronomers in our academic community; they are our connection to 65,000 years of continuous knowledge of the skies, and we aim to foster a positive relationship. A total of 4 out of a total of 514 (less than 1%) respondents answered Yes to the question "Do you identify as Aboriginal or Torres Strait Islander?" The 2021 Australia Bureau of Statistic census reports that Aboriginal and Torres Strait Islanders make up 3.8% of the Australian population. The Australian STEM careers pathway report (2024) found that 4% of respondents (N=141) were Indigenous. Benchmarked against the broader STEM workforce, we should expect ~20 indigenous Astronomers, not 4.

Do you identify as Aboriginal or Torres Strait Islander?		
Yes	No	**Total responses**
4 (<1%)	510	514

Table 10: Aboriginal or Torres Strait Islander responses to the Individual survey.

3.4 Citizenship, cultural and ethnic ancestry

The next three Figures (9, 10, 11) present data on the primary citizenship; primary and secondary cultural and ethnic ancestry. Primary citizenship is dominated by Australia at 57.8%, which hasn't moved from the 2015 report of 58% (although, as a percentage of the people who provided a response, the current figure would be 67%). In 2015 the whole of Asia represented 6%; whereas in the present survey responses India (6.6%) and China (2.2%) alone exceeded this number, indicating an increase in the number of people working in Astronomy with these primary citizenships. Investigating whether primary citizenship is a barrier to career advancement would require more a detailed investigation. For example, citizens of some countries require many-months wait for a visa to travel to conferences.

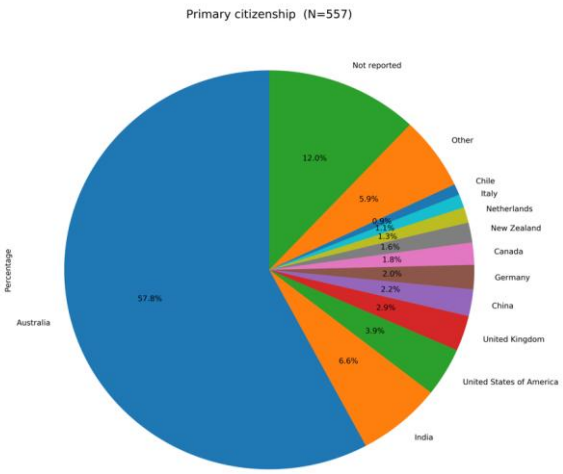


Figure 10: Primary citizenship for all respondents (N=557), including 12% not reported. Participants provided their primary citizenship in a text box.

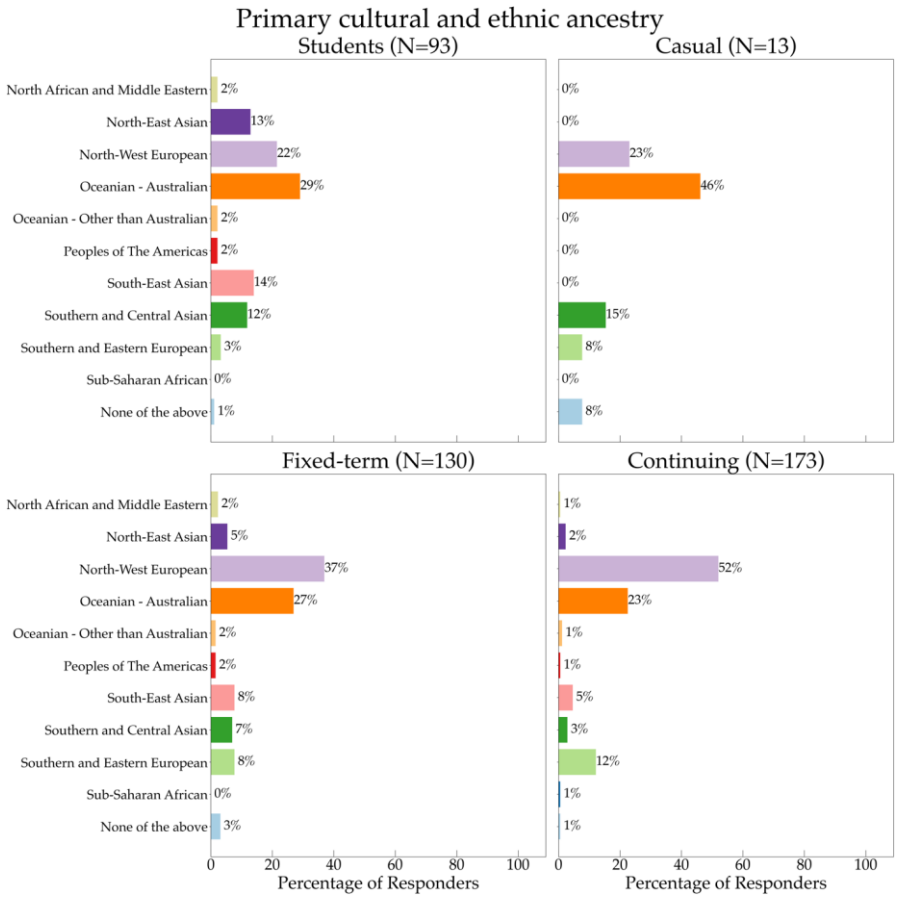


Figure 11: The primary cultural and ethnic ancestry of students (top left), casual staff (top right), fixed-term staff (bottom left) and continuing staff (bottom right).

To develop survey questions on primary and secondary cultural and ethnic ancestry we consulted the Australian Standard Classification of Cultural and Ethnic Groups (ASCCEG) as used by the Australia Bureau of Statistics. We adopted the 9 broad ASCCEG classifications, and split Oceanian into 'Oceanian - Australian' and 'Oceanian - Other than Australian'. A separate survey question is asked of Aboriginal and Torres Strait Islander Identity. The results are shown as a function of employment for primary and secondary cultural and ethnic ancestry in Figure 9 and 10, respectively. The percentage of European (North-Western, and Southern and Eastern) people increases from student (25%) to fixed-term (45%) through to continuing staff (64%), whereas the percentage of Asian (North-East, South-East, and Southern and Central) people

decreased from student (39%) to fixed-term (20%) through to ongoing staff (10%). We return to the question of cultural factors in career progression in section 5.6. A total of 116 respondents answered the question on secondary cultural and ethnic ancestry.

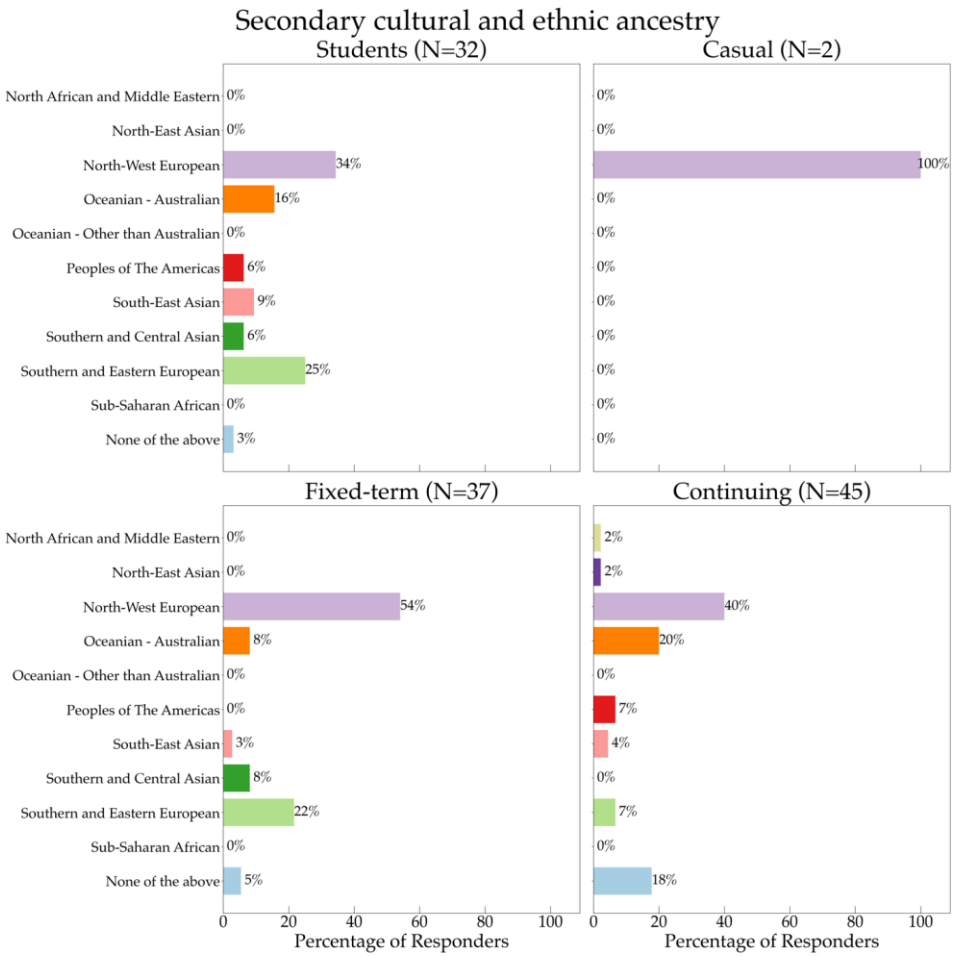


Figure 12: The secondary cultural and ethnic ancestry of students (top left), casual staff (top right), fixed-term staff (bottom left) and continuing staff (bottom right).

3.4 Disability, Chronic conditions and Neurodiversity

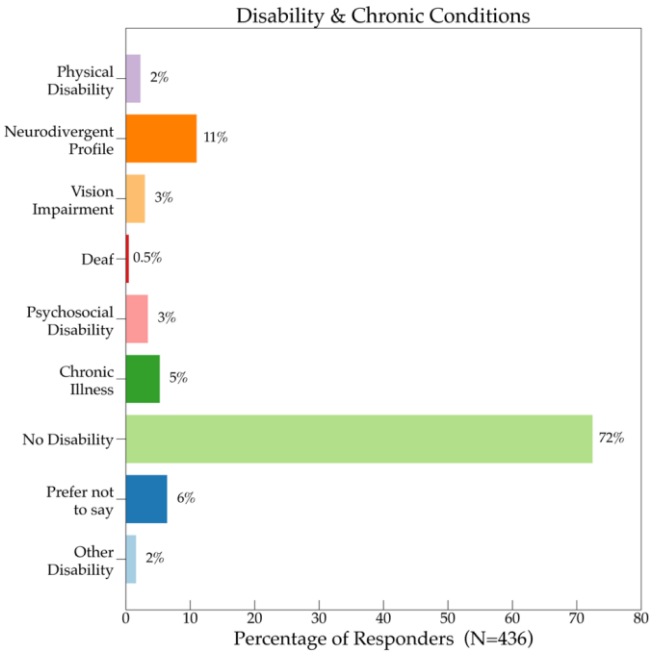


Figure 13: Responses to survey question on disability and chronic conditions. The Sum of percentages is higher than 100% due to some responses in multiple categories.

To develop the survey question on disability and chronic conditions we consulted the People With Disability Australia (PWDA) guide to language about disability. The question asked whether the participant identified as having any of a physical disability; neurodivergent profile (e.g. ADHD, Autism), vision impairment; deaf; psychosocial disability (Psychosocial Disability (e.g. mental health barrier to work participation), other disability, no disability, or prefer not to say. A total of 72% responded with 'no disability', and 6% preferred to not disclose this information. Meaning that 22% of the responders are either living with a disability, chronic condition or have a neurodivergent profile. The STEM Careers Pathway report states 18% for the prevalence of disability in the general population and report a level of 12% disability in their survey of STEM workers, including 32% of

those as neurodivergent, i.e. an overall neurodivergent percentage of 4%. Neurodivergent profile was also the most common response in this survey, and at an overall percentage of 11%, this is significantly higher than the all-of-Australian-STEM benchmark.

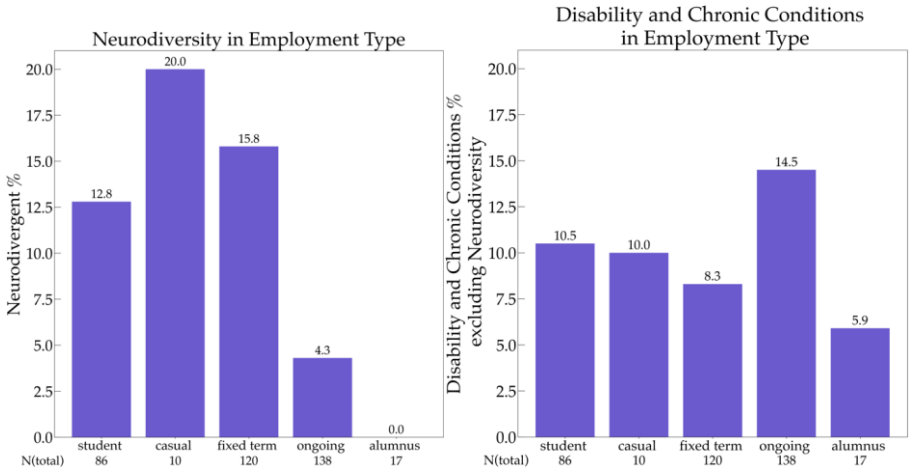


Figure 13b: Breakdown of disability as a function of employment type. Left: Percentage of people who identify as having a neurodivergent profile (ADHD, Autism etc). Right: Percentage of people who responded yes to any disability or chronic condition, excluding neurodiversity. A total of N=371 people responded with both their employment type and at least one disability, prefer not to say or no disability.

In Figure 13b we show the distribution of disability as a function of employment type. Postgraduate students and fixed-term (and casual) staff in Astronomy all have a significantly high percentage of neurodiversity, 13-16% (20%), a level that is three times higher than the STEM career pathways baseline of 4%. These numbers are in stark contrast to ongoing staff at 4%. One possible contributing factor is that working in Astronomy as a postgraduate, casual or fixed-term staff member is safe place for neurodivergent people. The stark change in the percentage between fixed-term and ongoing staff potentially identifies barriers for neurodivergent people to transition to an ongoing position, however, this may be skewed by the increasing neurodiversity diagnoses in young people (https://www.aihw.gov.au/reports/disability/autism-in-australia/contents/autism). The contrast with zero neurodiverse alumni is also stark (albeit low number statistics, if representative of the graduates, we would expect 2 responses instead of none). The

neurodiverse fixed-term staff progress their careers into ongoing or alumni. The low level of neurodiversity in these two cohorts point to the changing diagnoses level of young adults as the main contributing factor. A completely different career-stage profile is seen across the sum of all other disabilities and chronic conditions. As opposed to neurodiversity, the percentage of these disabilities are higher among ongoing staff, most likely due to age. Disability increases monotonically in the Australian population from 10% of 25-34 year olds, to 40% of 65-69 year olds (https://www.abs.gov.au/statistics/health/disability/disability-ageing-and-carers-australia-summary-findings/latest-release).

3.5 Primary role and research effort

3.5.1 Primary role

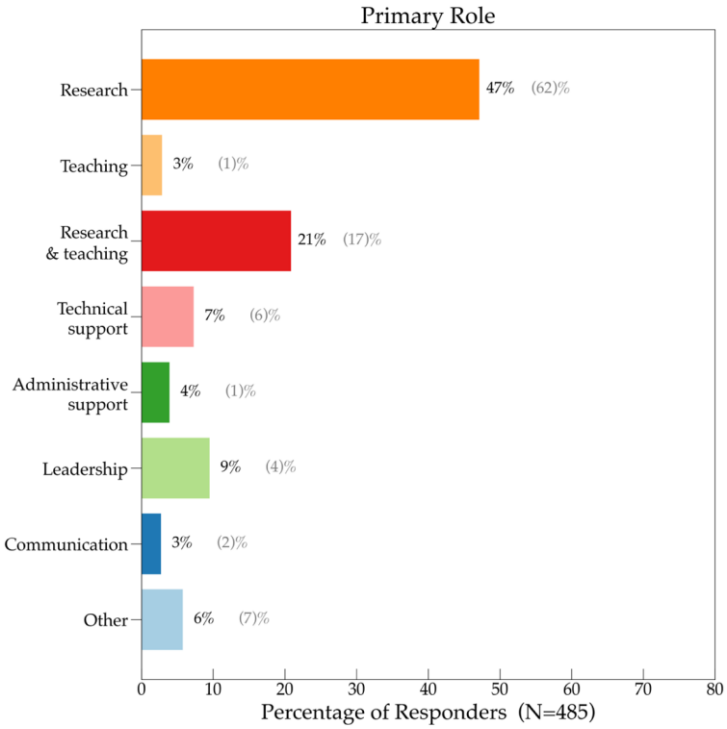


Figure 14: Primary Role of respondents to the individual survey. Percentages in grey are from the 2014 individual survey (N=467).

Survey participants were asked to nominate their primary role in the following categories: research, teaching, research & teaching; technical support; administrative support; leadership; communication and other. Figure 13 shows the percentage in each role compared with the 2015 survey. The results shows that the individual survey has either (i) been answered by people working in a wider range of roles in Astronomy, rather than pure research, or (ii) there has been a shift to a wider range of roles. The percentage of respondents with primary roles in teaching, research & teaching, technical support, administrative support, leadership and communication have all increased. The 'Other' category included descriptions of technical support roles, observatory operations and management roles.

3.5.2 Distribution of work hours

Percentage distribution of work hours	Postgrad student	Casual	Fixed term	Ongoing
Research	83.3	63.0	48.3	28.7
Teaching	7.4	9.5	6.7	14.0
Graduate Supervision	0.4	0.0	7.4	11.2
Technical/Software Support	0.3	0.0	14.5	5.6
Administration	2.6	0.9	8.0	14.2
Leadership	2.0	3.8	6.6	15.8
Science Communication	2.4	13.3	4.2	3.7
Other	1.5	9.5	4.3	7.0
Number	**95**	**13**	**136**	**174**

Table 11: Distribution of working hours for four different employment types: casual staff, postgrad students, fixed-term staff and ongoing staff. Survey participants were asked to nominate the percentage of their working hours spend on 8 task categories.

Survey participants were asked to nominate the percentage of their working hours spent on 8 task categories: Research (astronomical, astrophysics and instrumentation research); Teaching (undergraduate and postgraduate course work, undergraduate and Honours research supervision); Graduate Supervision (MSc by research and PhD students); Technical/Software Support; Administration (admin support and service roles), Leadership (local, national and international group leadership); Science Communication; and other.

The percentage of working hours spend on research is high for postgraduate students (83%), and drops through the staff employment types from casual (63%), fixed-term

contract (48%) to ongoing staff (29%). Notable peaks in the data include 15% of working hours of fixed-term staff on technical and software support, and 13% of casual staff hours spent on science communication.

3.5.3 Research Area of Astronomy

Astronomy Area	weighted %	number %
Astrobiology	0.4	2.4
Black holes/AGN/Quasars	7.1	19.1
Cosmology	5.2	15.7
Extragalactic astronomy	18.6	33.0
Galactic and Local Group astronomy	5.4	14.8
General Relativity	0.8	5.2
Gravitational waves	4.1	12.0
Instrumentation - Ground-based optical/IR	4.3	10.9
Instrumentation - Ground-based radio	4.3	10.7
Instrumentation - Gravitational waves	3.3	5.4
Instrumentation - other	0.5	2.6
Instrumentation - research and development	2.7	10.2
Instrumentation - science applications	1.1	6.3
Instrumentation - Space-based	1.5	5.9
Instrumentation - technical/engineering	3.3	6.7
Mesospheric, Ionospheric and Magnetospheric Physics	0.0	0.7
Multi-messenger astronomy	1.7	9.8
Planetary science - Solar System	0.7	2.4
Planetary science - exoplanets	3.5	8.5
Pulsars	3.6	10.0
Space physics	0.4	1.7
Space physics - high energy	0.9	2.8
Star formation and interstellar medium	4.6	12.6
Stellar astronomy	6.6	15.7

Stellar astronomy - Sun	0.7	1.7
Time domain astronomy	6.1	17.0
None of the above	4.6	4.8
Other	4.4	6.7

Table 12: Distribution of Astronomy effort across N=460 respondents listed in order of percentage research effort. The second column is the weighted percentage effort, i.e. normalised over all responses. The third column is the number of any non-zero responses to that category as a percent of all respondents to this question (N=446).

Survey participants were asked to nominate the percentage of their research effort in across different areas of astronomy. The summed percentage effort across 28 different areas is listed in Table 12. Compared with the 2014 survey, Instrumentation as a whole (sum of 8 categories) has increased in weighted research effort from 13% to 21%, overtaking Extragalactic astronomy as the most popular area of astronomy research. The list of astronomy research areas has expanded compared with 2014, thus a direct comparison is not straightforward. 12% of the community gave a non-zero response to research in gravitational waves. 17% of the community gave a non-zero response to research in time-domain Astronomy.

3.5.4 Distribution of Astronomy Techniques

Technique	weight %	number %
Archival research	5.1	24.6
Astroparticle physics	0.8	5.2
Computational - non-theory	7.8	23.9
Gamma-rays	0.9	5.2
Gravitational Waves	4.9	11.5
Infrared	4.6	20.2
Machine learning/Artificial Intelligence	3.4	17.2
Neutrinos	0.1	1.5
Numerical methods / Software	9.4	29.6
Optical	20.1	45.9
Radio	16.3	34.3
Theory analytical	3.7	14.3
Theory Computational	6.8	20.7
UV	1.4	9.3
X-ray	0.6	5.7
Other	1.8	4.3
Do not conduct astronomical research	12.3	12.2

Table 13: Distribution of Astronomy techniques. The second column is the weighted percentage effort, i.e. normalised over all responses. The third column is the number of any non-zero responses to that category as a percent of all respondents to this question (N=446).

Table 13 gives the nominated percentage of research in across astronomy techniques. The percentage use across 15 different techniques is listed in the second column. The 2014 survey simply asked participants to nominate *which* techniques they used (out of 7 categories), rather than a percentage, and presented results for the non-student researchers only, thus the results in the third column are best compared directly with the 2015 report (modulo student responses). We advocate for students to continue to be included in this census of research areas since student spent a larger fraction of their working hours dedicate to research (see Table 11). All categories appear to have decreased in percentage, mostly likely due to the expansion of the number of categories. Archival research is pursued by a quarter of the community (24.7%). Machine learning/Artificial Intelligence techniques are used by 17% of people working in Astronomy.

3.6 Educational history

3.6.1 Highest Degree – student and non-student

Highest Degree	**All (%)**	**Non-student(%)**
Bachelor	4.6	3.8
Bachelor with Honours	15.9	6.3
Master	15.5	7.8
Doctor of Philosophy	62.3	80.3
Other	1.7	1.9
Total	**414**	**319**

Table 14: Highest degree award for all survey participants (N=414), and non-student survey participants (N=319).

The educational history reveals that 62% (80%) of survey all (non-student) participants have obtained a PhD. This is similar to the 2014 survey where 61% of all respondents to the survey, however the current survey has a lower percentage of PhD qualifications among the non-student cohort (85% by comparison).

3.6.2 Highest qualification – all employment types

	Highest qualification							
Employment	PhD	MSc	Bachelor	Bachelor (Hons)	Diploma	Other	None	Not reported

Astronomy Alumnus	19	0	0	0	0	1	0	0
Casual work	7	2	2	1	1	0	0	0
Fixed-term contract	101	13	7	9	1	5	0	0
Ongoing/continuing	148	10	3	10	2	1	0	0
Post-graduate student	2	39	7	46	0	1	0	0
Not reported	38	20	4	15	1	3	5	33
Total	**315**	**84**	**23**	**81**	**5**	**11**	**5**	**33**

Table 15: Highest qualification of survey participants as a function of employment type.

Table 15 can be compared directly with Figure 34 in the 2015 Decadal Plan WG3.1 report, which shows that 88% (87%) of ongoing (fixed term) staff were PhD qualified. In the table above from the 2024 survey, we find that 86% (75%) of ongoing (fixed term) staff are PhD qualified. This distribution most likely reflects the broader range of roles with the astronomy workforce that have responded to the survey this time.

3.6.3 Year of completion for highest qualification

	Date of most common highest qualification		
Category	**Median**	**0.25**	**0.75**
Astronomy Alumnus	2008	1983	2016
Casual work	2001.5	1981.25	2009.75
Fixed-term contract	2018	2013	2021
Ongoing/continuing	2005	1996.75	2010
Post-graduate student	2021	2020	2022
Not reported	2012.5	2002.25	2021.75

Table 16: Median, bottom quartile and top quartile year of award for the most common highest qualification as function of employment type.

Year of completion for highest degree	percent	difference
1960-1969	0.5	
1970-1979	0.7	
1980-1984	0.7	-0.3
1985-1989	3.4	-0.6
1990-1994	4.2	1.2
1995-1999	6.1	1.1
2000-2004	8.8	2.8
2005-2009	12.3	3.3
2010-2014	9.8	-4.2
2015-2019	16.9	-3.1
2020-2024	36.5	-0.5

Total	**408**	

Table 17: Year of completion of the highest degree by (N=408) survey participants. The difference column is the difference between the percentage respondents in the current survey and the corresponding cohort (i.e. ten years later) in the previous decadal survey.

Table 17 reveals a very similar distribution of years since completion of the highest degree compared with participants in the previous decadal survey. The difference between the percentage respondents in the current survey and the corresponding cohort (i.e. ten years later) in the previous decadal survey is less than 5 for all year ranges. For example, this survey (2020-2024) and last survey (2010-2014) both had 37% of participants complete their highest degree in the last 5 years. Nevertheless, the negative different values in the most recent cohorts, coupled with the positive numbers in the 1990-2009 cohorts means the astro community is more mature now.

3.6.4 Country or Continent of highest degree

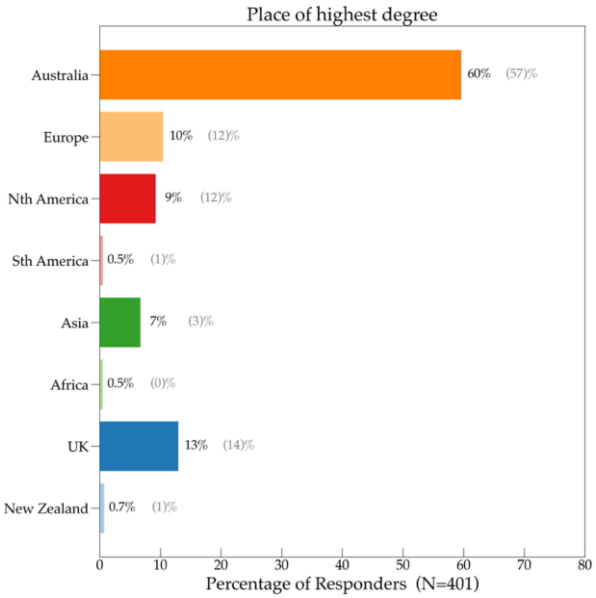


Figure 15: Country or Continent of highest degree. Percentages in grey are from the 2014 individual survey (N=495).

Survey participants were asked to state the country of their highest degree. The results for all countries except Australia, UK and New Zealand are aggregated into continents in Figure 15. Australia is the most popular response for place of highest degree (60%),

increasing slightly from the 2015 report (57%). The number of survey participants with their highest degree from an Asian country (7%) has doubled in the last decade (3% in the previous survey).

3.6.5 First in family to complete highest degree

	First in family to complete highest degree			First to do PhD		
Category	**Yes**	**No**	**Not reported**	**Yes**	**No**	**Not reported**
Astronomy Alumnus	15	5	0	-	-	-
Casual work	8	5	0	-	-	-
Fixed-term contract	96	38	2	-	-	-
Ongoing/continuing	124	50	0	-	-	-
Post-graduate student	49	45	1	71	16	8
Not reported	59	26	34	-	-	-

Table 18: First in family to complete highest degree; and for PhD students only, whether they are first in their family to study a PhD.

3.6.6 First in family – cultural and ethnic ancestry

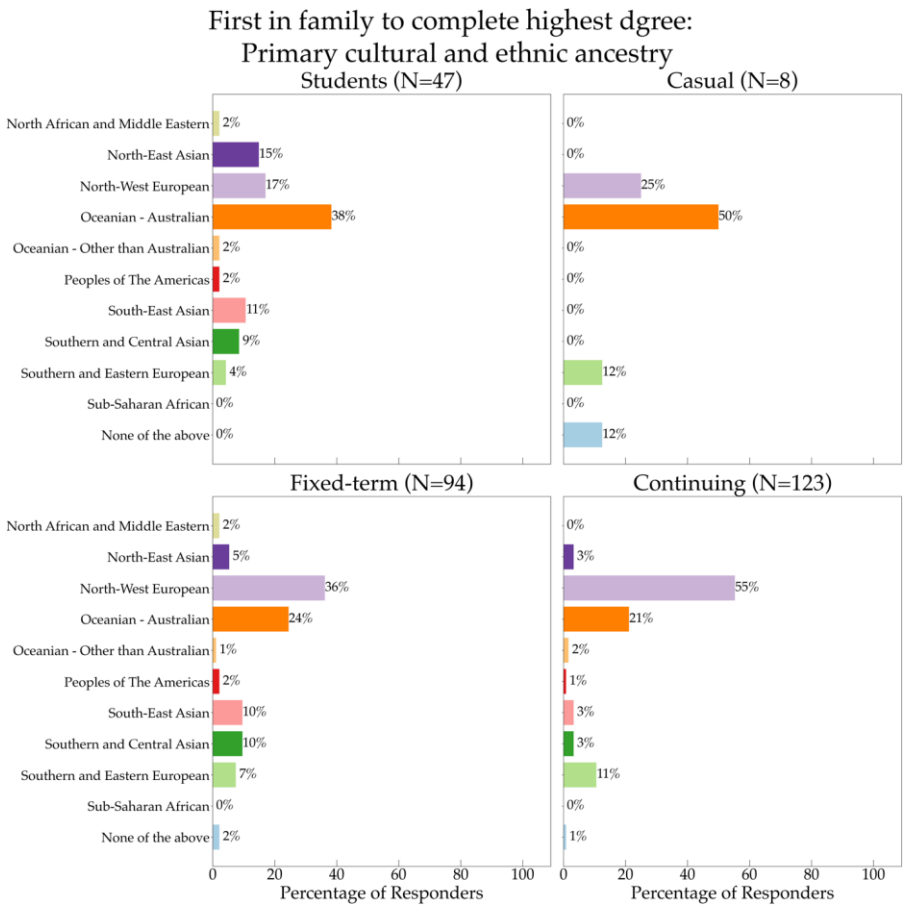


Figure 16: First in Family to complete their highest degree, shown as a distribution of primary cultural and ethnic ancestry for each employment type.

Figure 16 is designed to be compared directly with Figure 11. The distributions of primary cultural and ethnic ancestry for survey participants who are the first in their family to complete their highest degree are remarkably similar to all participants - varying only by 1-2 percentage points across all ancestries. This is interpreted as meaning that being the first in your family to complete a PhD in addition to having any particular ancestry/ethnic background is no additional barrier to be being employed in Astronomy in either a fixed-term or continuing position. 'First in family' student demographics should be analysed with caution since there are fewer than 10 students in each group. Postgraduate students were asked if they were the first in the family to study a PhD. The overwhelming response was yes, with N=95/117 (85%).

3.7 Student supervision

Supervisory load								
	Honours	Honours (%)	Masters	Masters %	PhD	PhD %	All	All %
Women fixed term	8	31%	2	13%	27	39%	37	33%
All fixed term	26	26%	15	20%	70	19%	111	20%
Women ongoing	18	24%	15	25%	79	26%	112	26%
All ongoing	75	74%	61	80%	299	81%	435	80%
Total	**101**		**76**		**369**		**546**	

Table 19: Supervisor load for fixed-term (N=136) and ongoing staff (N=174) that responded to the survey.

Survey participants in fixed-term and ongoing positions were asked to provide the number of currently enrolled postgraduate students for which they are the primary supervisor. The number of students were given in 3 categories: Honours, Masters and PhD. There are more Honours and PhD students captured by this question than the Institute survey shown in Figure 1. This may be due to double counting of some supervisory loads, i.e. students having multiple supervisors.

We first consider the relative distribution of supervisory load between fixed-term (N=136) and ongoing (N=174) staff. We find that fixed-term staff carry 20% of the supervisory load across all student categories, with a higher fraction of Honours students. For this questions response, 40% of fixed-term positions are women and 29% on ongoing positions are women. Table 19 shows that 33% of the fixed-term staff supervisory load is carried by women, and 26% of the ongoing staff supervisory load is carried by women. In both cases this is 3-7 percentage points lower than their representation in this part of the survey.

The 2015 report focused on the PhD (rather than all) student supervisory load. In this previous decade, fixed-term staff carried 14% of the PhD supervisory load (compared with 19% now). This difference robust and not due to different survey demographics since both decades have similar proportions of fixed-term to ongoing staff. Women carried 14% of the ongoing PhD supervisory load (compared with 26% now). Benchmarked against women being 21% of ongoing staff (N=27/102) in this part of the 2015 report, the trend of women supervising fewer PhD students remains the same over the decade.

PART 4. GRADUATE OUTCOMES RESULTS

4.1. PhD graduates

Institutions were asked to provide information, where available, on employment outcomes for their PhD graduates. Institutions were asked to provide the graduates' employment area, type, and location, one year and four years after graduation. Table 20 provides a summary of the data.

Institution	1-year data	4-year data	Completeness (1 year)	Completeness (4 year)
ANU	30	10	75%	100%
Swinburne	44	12	94%	92%
ICRAR/UWA	27	0	93%	0%
Monash	26	11	100%	79%
UNSW Sydney	14	3	100%	100%
UQ	10	2	100%	100%
UTAS	9	3	100%	100%
TOTAL	160	41	91%	80%

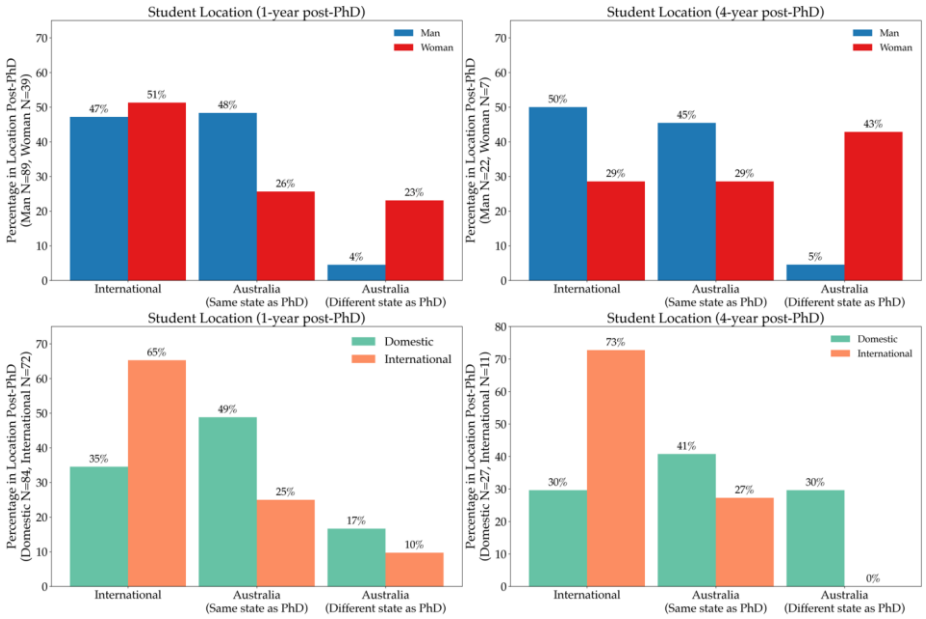
Table 20: PhD graduate employment outcomes.

Seven institutions from six states or territories submitted information on PhD graduate employment outcomes. Data covering the first job after PhD completion exists for >90% of reported graduates, and for >80% four years after PhD completion. The sample can therefore be considered representative of the broader Australian astronomy PhD graduate cohort.

60% of men and 71% of women graduates were working in academia one year after graduation, with 32% of men and 24% of women instead working in industry, 6% of men and 5% of women in government employment, and 2% men and 0% women in teaching jobs. This represents a slight shift away from academic employment compared to a decade earlier: of graduates with reported outcomes in the 2016-2025 survey, 77% were in academia, 19% in industry (this definition included government employment in the last Decadal Survey), and 3% in teaching. Those employed in academia were overwhelmingly in astronomy research positions, while those industry were primarily working in data science, with a small number of astronomy PhDs working in finance, natural resources, digital technology, not-for-profit and other industry sectors. Domestic and international students appear to have similar employment outcomes. The fraction of graduates employed outside academia is significantly higher than the 6% of students reported to have undertaken an internship during their PhD; 49% of students did not undertake an internship, and data was not available for the remaining 46%.

Survey data allow us to examine the mobility of astronomy PhD graduates by comparing employment one and four years post-PhD. 15% of graduates changed their employment type, predominantly moving from astronomy research to data science. This change may be particularly pronounced for women: 43% of women graduates were employed in data science four years after completing their PhD compared to 21% one year post-PhD (we note, however, that data for only 7 women is available four years post-PhD); for men the numbers were 30% and 22%, respectively. International students are more likely to make the move to data science later in their careers: 25% of international graduates worked in data science four years after completing their PhD, compared to 18% one year out; while the numbers for domestic graduates were almost unchanged (26% and 25%, respectively).

Geographically, international graduates are, perhaps unsurprisingly, much more likely to move overseas after their PhD than domestic graduates. Women are more likely to move interstate than men for their first post-PhD job.



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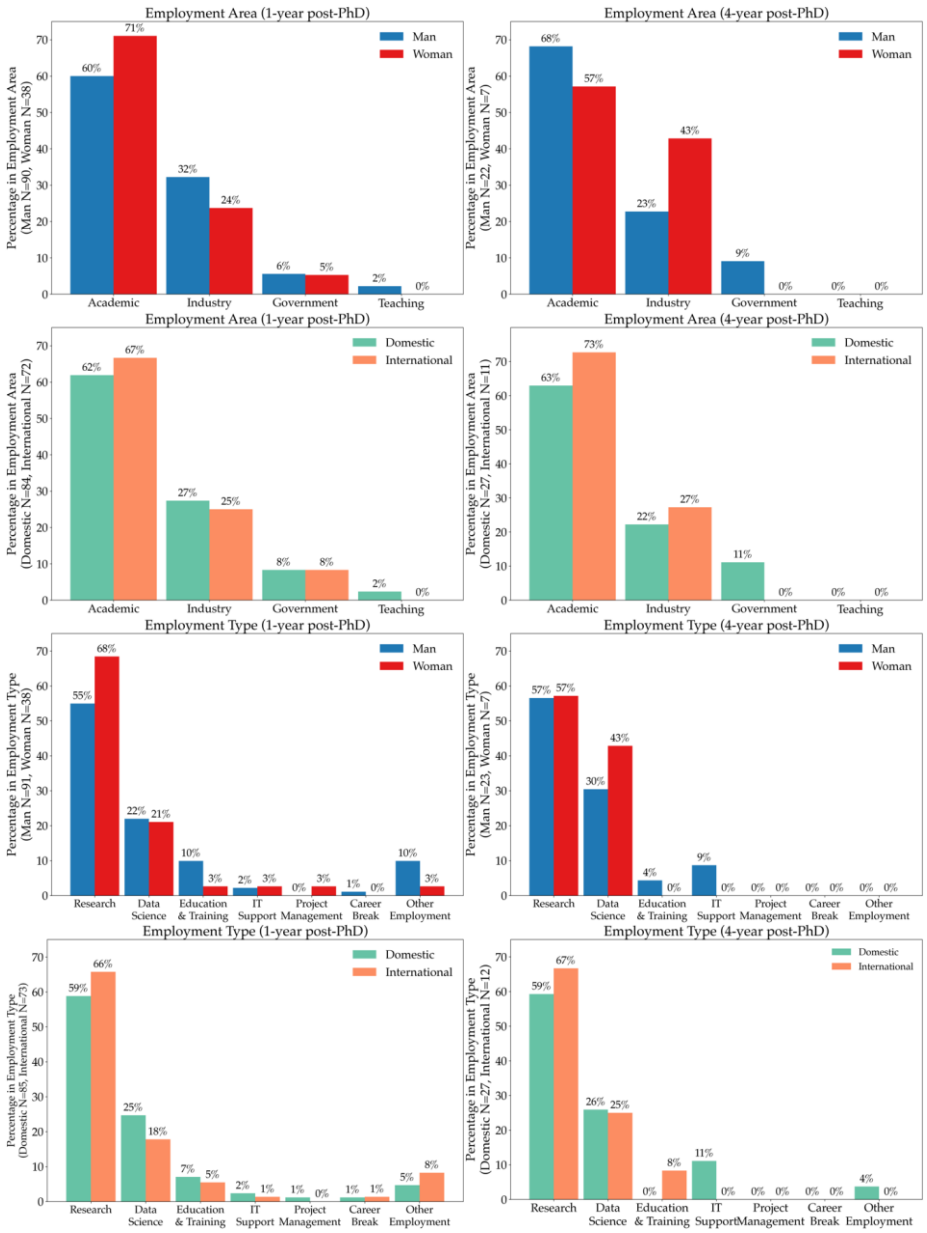
Employment Area (1-year post-PhD)
Percentage in Employment Area (Man N=90, Woman N=38)
Man
Woman
60%
71%
32%
24%
6%
5%
2%
0%
Academic
Industry
Government
Teaching
Employment Area (4-year post-PhD)
Percentage in Employment Area (Man N=22, Woman N=7)
68%
57%
23%
43%
9%
0%
0%
0%
Employment Area (1-year post-PhD)
Percentage in Employment Area (Domestic N=84, International N=72)
Domestic
International
62%
67%
27%
25%
8%
8%
2%
0%
Employment Area (4-year post-PhD)
Percentage in Employment Area (Domestic N=27, International N=11)
63%
73%
22%
27%
11%
0%
0%
0%
Employment Type (1-year post-PhD)
Percentage in Employment Type (Man N=91, Woman N=38)
55%
68%
22%
21%
10%
3%
2%
3%
0%
3%
1%
0%
10%
3%
Research
Data Science
Education & Training
IT Support
Project Management
Career Break
Other Employment
Employment Type (4-year post-PhD)
Percentage in Employment Type (Man N=23, Woman N=7)
57%
57%
30%
43%
4%
0%
9%
0%
0%
0%
0%
0%
0%
0%
Employment Type (1-year post-PhD)
Percentage in Employment Type (Domestic N=85, International N=73)
59%
66%
25%
18%
7%
5%
2%
1%
1%
0%
1%
1%
5%
8%
Employment Type (4-year post-PhD)
Percentage in Employment Type (Domestic N=27, International N=12)
59%
67%
26%
25%
0%
8%
11%
0%
0%
0%
0%
0%
4%
0%

Figure 17: PhD Graduate student outcomes: student location, broad employment area and employment type as a function of gender and domestic/international students. Left column is the 1-year post-PhD outcome. Right column is the 4-year post-PhD outcome.

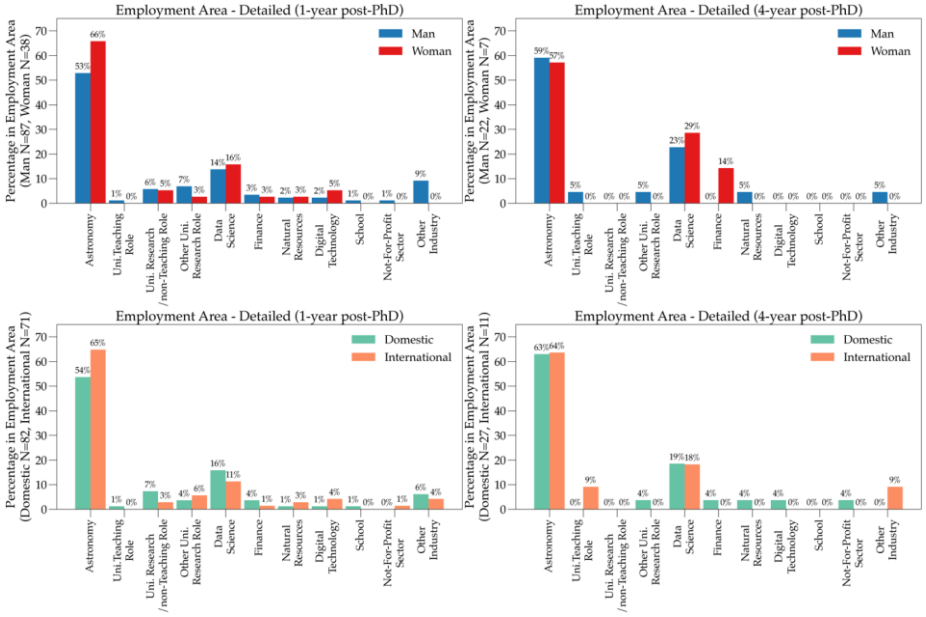

Figure 18: PhD Graduate student outcomes: detailed employment area as a function of gender and domestic/international students. Left column is the 1-year post-PhD outcome. Right column is the 4-year post-PhD outcome.

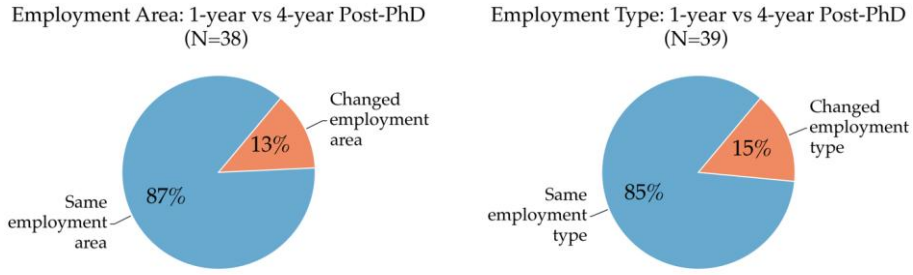

Figure 19: PhD Graduate student outcomes: Percentage change from 1-year to 4-year post-PhD. Left chart is the broad employment area (academic, industry, government, teaching) ; Right chart is the Employment type.

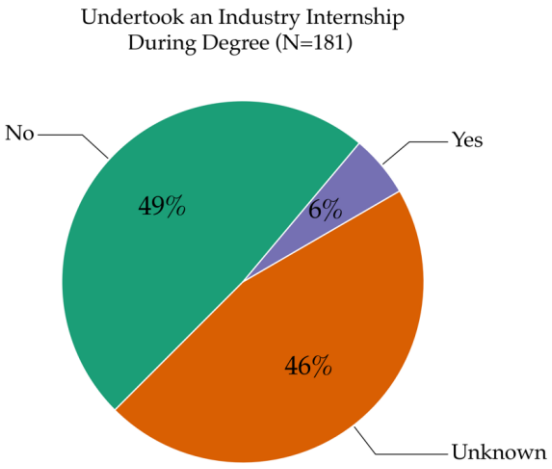

Figure 20: PhD Graduate student outcomes: Percentage of students who undertook an industry internship during their degree.

4.2. Honours graduates

Anonymised data relating to Honours students' pre-Honours study location and post-Honours outcomes was supplied by departments over the 5-year period 2019-2023. 168 students graduated from Australian universities in this period, a very similar number to a decade ago (167 over 2009-2013), suggesting that the Honours pipeline has stabilised after a period of growth two decades ago. The overwhelming majority of incoming Honours students in 2019-2023 (88%) were already studying at their host university; only 10% came from another Australian university; and 1% from an international university. These numbers are largely unchanged from a decade ago. Information about post-Honours careers was available for 75% of the students. Of students for whom data was available, After their Honours degree, 63% stayed on for a postgraduate degree (overwhelmingly a PhD) at the same university; 13% went into PhD programs at another university (approximately equally split between Australia and international); 4% to further studies elsewhere; and 20% into direct employment. The mobility of Australian astronomy Honours graduates has increased: compared to a decade ago, the fraction of Honours graduates doing directly into employment has increased (12% of Honours graduates for whom data was available in 2014, compared to 20% in 2024), as has the fraction going on to further study at a different institution (13% a decade ago compared to 17% in 2024);

these increases have come largely at the expense of continuing on to higher degree studies at the same university (77% a decade ago compared to 63% in 2024).

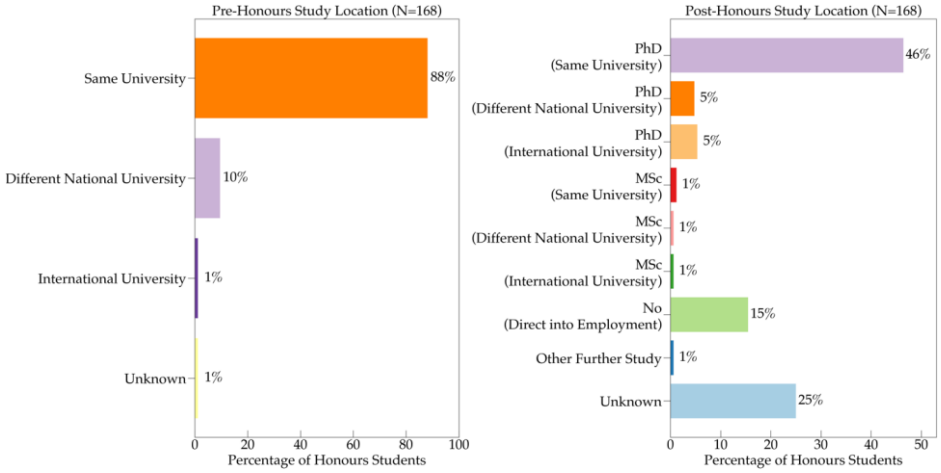

Figure 21: Left: Pre-honours study location. Right: Post-honours study location.

PART 5. CAREER PATHWAYS

5.1. Graduate student backgrounds

We begin examination of career pathways by considering backgrounds of astronomy postgraduate students. All 95 respondents who identified themselves as postgraduate students provided information on the area of their previous degree. The majority specialised in astronomy and/or physics. Mathematics, computer science and engineering contributed 14% of degrees, with the remainder including statistics, economics and even studies in religion. Many students reported degrees in multiple areas, consistent with the double-major / double-degree philosophy of many Australian universities.

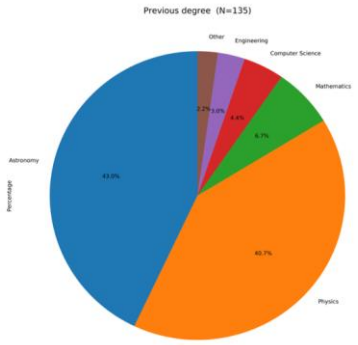

Figure 22: Previous degree type of postgraduate Astronomy students.

5.2. Fixed-term staff contract length and mobility

136 fixed-term staff completed the individual survey. This comprises 24% of all respondents, and 31% of respondents who reported their employment status. The actual percentage of staff in fixed-term employment in Australia astronomy is significantly higher than this, comprising 53% of all astronomers in continuing, continuing contingent, fixed-term and casual positions reported in the institutional survey data. By contrast, continuing and continuing contingent staff make up 40% of people working in astronomy, with the remainder in casual employment.

Astronomy staff therefore have significantly less job security than the typical Australian STEM sector employee (66% permanent full time contract; STEM Career Pathways 2023), and even than typical university STEM employees (49%). Recent analysis of the Australian STEM sector (STEM Career Pathways, 2023) showed that PhD graduates were less likely to be in secure employment positions, and astronomy staff are both overwhelmingly PhD-qualified (see *Table 15)* and employed at universities (*Table 1*).

Three quarters of respondents were on contracts at least two years in duration, and 58% on contracts of at least three years. These numbers are comparable to, and slightly better, than the average conditions across STEM in Australia (STEM Career Pathways 2023, Table 3). 11% of respondents were on very short-term (less than one year) contracts.

More than a third (37%) of fixed-term respondents working in Australian astronomy reported their previous position being outside Australia. More than half of respondents held previous positions in Australasia, a quarter in Europe, and 12% in North America.

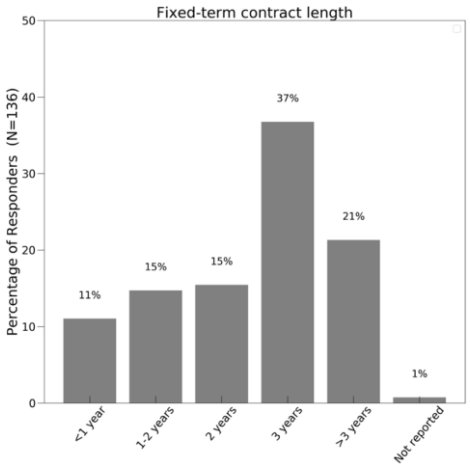

Figure 23: Current contract length for fixed-term staff.

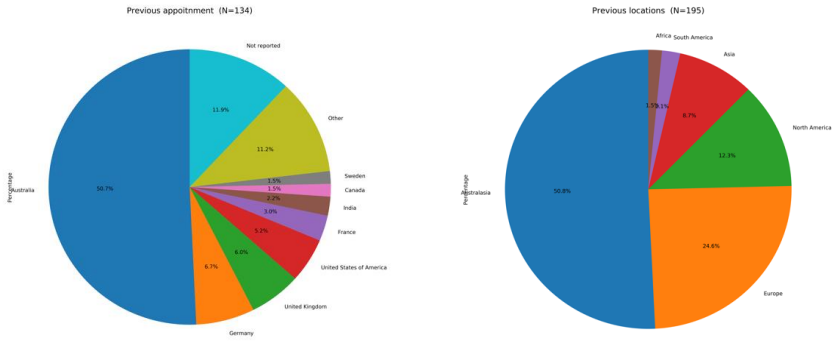

Figure 24: Country of previous appointment for fixed-term respondents (left) and continents on which fixed-term respondents have previously worked (right). The total number of responses in the right panel exceeds the number of respondents (136) because some respondents have worked on multiple continents.

5.3 Gender and carer responsibilities

We next examine pathways to ongoing positions in astronomy. Meta analysis of international datasets by Ceci et al. (2023) showed that both gender and carer responsibilities can be important factors in academic and STEM career progression. We therefore split the respondent cohort by these characteristics. Only men and women provided sufficiently large samples for the gender analysis, hence we consider these below.

Demographic	Number of respondents	PhD year: median	PhD year: 25%	PhD year: 75%
Ongoing Woman	52	2008	2001	2015
Ongoing Man	117	2004.5	1995.75	2009.25
Ongoing Woman+carer	26	2005	1999.5	2011.75
Ongoing Woman-carer	26	2013	2004	2022
Ongoing Man+carer	52	2006	2001	2009
Ongoing Man-carer	65	2002	1990	2011
Fixed-term Woman	55	2018	2015	2021
Fixed-term Man	74	2017	2011.25	2021
Fixed-term Woman+carer	19	2012	2004.5	2016.5
Fixed-term Woman-carer	36	2020	2018	2021.5
Fixed-term Man+carer	28	2012.5	2005.75	2017.25
Fixed-term Man-carer	46	2020	2016.25	2012

Table 21: Median, bottom quartile and top quartile year of award for different demographic groups of PhD qualified Astronomers. "+carer" means Astronomer with carer responsibilities, "-carer" means Astronomer without carer responsibilities.

Of those in ongoing positions, women with carer responsibilities tend to be academically "older" (median PhD year 2005) compared to women without carer responsibilities (median PhD year 2013). It is relatively rare to have children during PhD: only 1 of 36 women and 7 of 51 men respondents who are current PhD candidates reported having carer responsibilities, which would include children as well as other responsibilities. Half of the women in ongoing positions reported being within 19 years of their PhD (median PhD completion year 2005), and 75% within 24 years (75th percentile is year 1999.5). By contrast, the cohort of women in ongoing positions with no carer responsibilities is academically younger, with a median PhD year of 2013 and interquartile range of 2004 - 2022. It is therefore reasonable to conclude that the bulk of carer responsibilities in the respondent cohort of women is likely to be related to children.

The distributions of PhD completion years for men with carer responsibilities in ongoing positions is similar to women with carer responsibilities, albeit with a slightly narrower interquartile range for men (median year 2006, interquartile range 2004 - 2022). These dates are again suggesting of children as the likely factor.

By contrast, men without carer responsibilities tend to have obtained their PhDs earlier (median year 2002, interquartile range 1990-2011) than any other cohort. It is unclear whether or not this cohort had carer responsibilities in the past (e.g. children who have now grown up and are independent).

In fixed-term positions, the gender ratio is much closer to parity (55 women, 74 men) than ongoing positions (52 women, 117 men). For both women and men, a lower fraction of fixed-term staff have caring responsibilities, with 35% of women and 38% of men in fixed-term positions reporting these compared to 50% of women and 44% of men in ongoing positions. This is likely to be related to fixed-term staff having completed PhDs more recently. Fixed-term staff with carer's responsibilities completed their PhDs less recently than those without (median difference 7.5 years for men, 8 years for women) for both women and men, but still several years later (6.5 years for men, 7 years for women) than ongoing staff with dependents. There is no clear difference in "PhD age" between men and women with dependents, at either fixed-term or ongoing staff level, except for a slight prevalence of men in fixed-term positions 10-12 years post-PhD.

5.4. Transition to ongoing positions

Figure 22 shows the distribution in the number of fixed term positions held before an ongoing position. There is a clear gender difference, with women most likely to get an ongoing position after two fixed-term ones, and men after three.

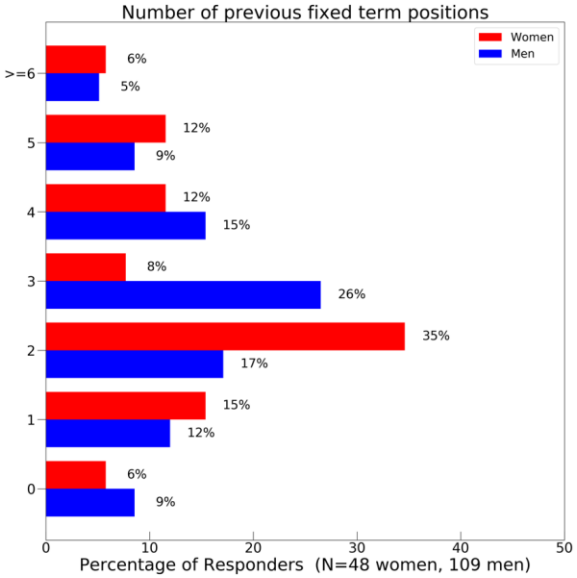

Figure 25: Number of previous fixed-term positions held before an ongoing position as a function of gender.

A deeper look suggests that having dependents appears to play a role. Women with dependents are *more* likely to get a permanent position after fewer fixed-term roles: 65% of women with dependents did this after two or fewer fixed-term contracts compared to 46%

of women with no dependents. Men take slightly longer to land ongoing positions, with only 38% obtaining permanent positions after two postdocs or fewer. For men who answered the survey the relationship between getting an ongoing position and being a carer is less clear: 41% of men with carer responsibilities and 35% without obtained an ongoing position after two or fewer fixed-term contracts, and 68% (with carer responsibilities) and 61% (without) did this within three. The apparent lack of "carer penalty", especially for women, is in contrast to previous findings in the STEM and academic literature (Ceci et al. 2023, Office of the Chief Scientist 2020).

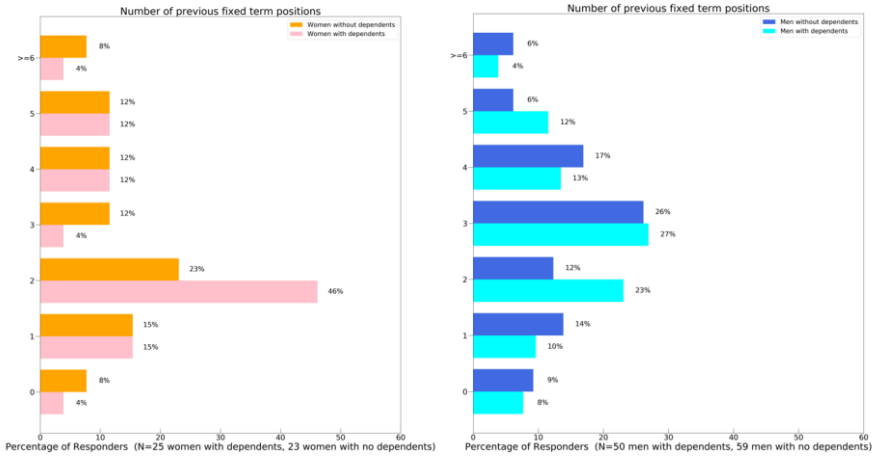

Figure 26: Number of previous fixed-term positions for women (left) and men (right), with and without dependents.

5.5. Career interruptions

We next explore whether career pathways relate to career interruptions, both in number and duration.

For those in ongoing positions, there is a clear difference between women with carer responsibilities and other cohorts such as women without carer responsibilities and men. 88% (23 of 26) of women in ongoing positions with dependants reported at least one career interruption of a month or longer, with a median total interruption equivalent to 1.8 FTE years, and an interquartile range of 1-2.8 FTE years. This is significantly longer than women without carer responsibilities, 35% of whom reported interruptions (9 of 26 respondents) with a median interruption of 0.5 FTE years. Men without carer responsibilities fared similarly, with 31% (20 of 62 respondents)) reporting interruptions, also with a median of 0.5 FTE. While men with carer responsibilities were more likely to report interruptions (56%, 29 of 52 respondents), the median interruption of 0.5 FTE was similar to both men

and women without dependents. Hence women carers are the significant outlier, with a much higher median interruption than the other cohorts. This may help to explain the lower number of previous fixed-term positions and older "academic ages" reported by women with carer responsibilities in ongoing positions. If an appreciable fraction of women come back to work part-time after interruptions, they are likely to develop more professional experience over a longer timeframe than those without career interruptions, making them competitive for ongoing positions after a smaller number of fixed-term contracts.

5.6 Seniority

Just over 50% of individual respondents (280 people) indicated their level of seniority. 67 respondents were employed at entry level (equivalent to academic level A at an Australian university); 91 at mid-career level (levels B or C at a university), 90 at senior level (academic level D or E), and 32 held executive positions.

5.6.1 Gender

Analysis of positions by gender shows a clear trend towards men in more senior positions, with men outnumbering women approximately 4:1 at senior (university associate professor / professor, or equivalent) level. Interestingly, this gender imbalance is lower (but still very pronounced) at the most senior, executive, level. These trends are broadly consistent with those in the overall Australian STEM ecosystem (STEM Career Pathways 2023, Table 18), with analysis of a self-reporting sample suggesting that women are overrepresented at entry and mid-career levels, underrepresented at senior levels, and appropriately represented at executive levels.

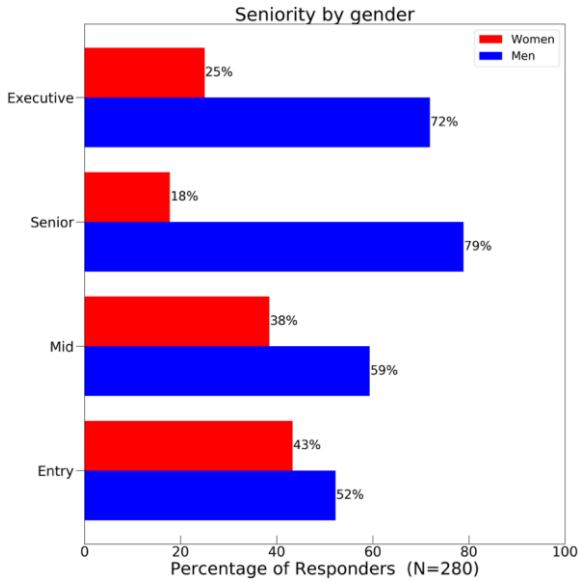

Figure 27: Seniority for men and women. Percentages in each seniority category are normalised to the total number of respondents in that category, they don't add to 100% (typically 97%) because gender is not binary.

As shown in Section 5.1, men in Australian astronomy tend to have completed their highest degree, typically a PhD, earlier than women. We attempt to control for academic age by considering only those respondents who completed their highest degree (typically a PhD) between 2010 and 2019; this yields the largest 10-year cohort of respondents who have had time to progress to senior levels. This sample consists of 41 women and 47 men. There is gender parity at senior level (8 women, 8 men), with a slight preference for men at mid-career level and women at early-career level. None in this cohort have yet progressed to executive level.

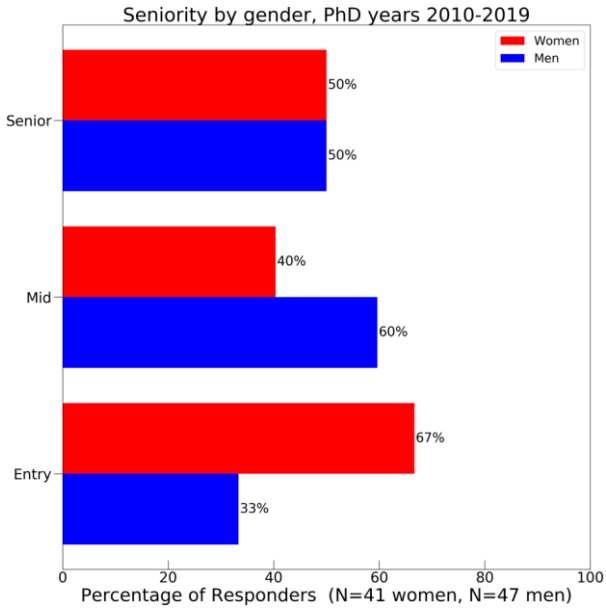

Figure 28: Seniority by Gender, PhD years 2010-2019.

5.6.2 Cultural and ethnic background

271 respondents reported their cultural and ethnic ancestry in addition to career level. Respondents could identify up to three relevant ethnic groupings, drawn from Australian Bureau of Statistics standard classifications. North-West European (47% of those respondents who provided information), Oceanian-Australian (25%), and Southern and Eastern European (11%) were the largest cultural and ethnic groups. North-East Asian, South-East Asian, and Southern and Central Asian respondents numbered between 3-5% each; with North African and Middle Eastern, Peoples of the Americas, and None of the Above comprising approximately 1% each.

While North-West Europeans and Oceanian-Australian groups comprise 72% of the respondents, they are underrepresented (49%) at entry level, and overrepresented at senior (83%) and executive (93%) levels. The third-largest group, Southern and Eastern Europeans, are overrepresented by a factor of 1.5 at entry level, and underrepresented by the same factor at the executive level.

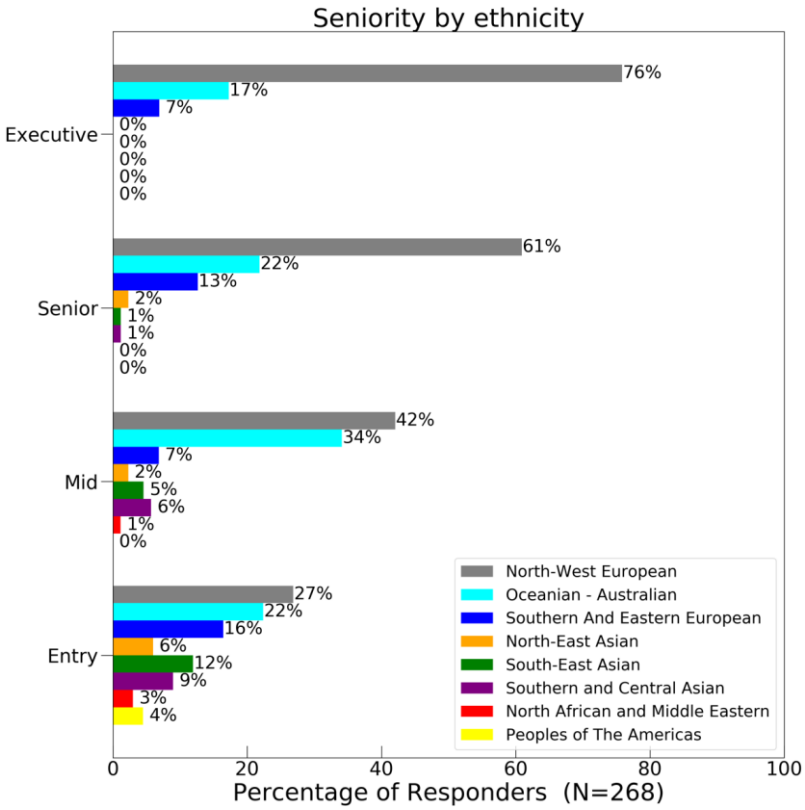

Figure 29: Seniority by cultural and ethnic background for all respondents who provided this information. North-West Europeans and Oceanian-Australian backgrounds are overrepresented in the most senior positions, while other groups are underrepresented.

Non-European respondents were most clearly overrepresented at entry level (34% compared to an overall population percentage of 14%) and underrepresented at senior (4%) and executive (0%) levels.

To account for potential biases in these results due to the mixing of permanent and medium-term Australian resident cohorts (for example, some cultural and ethnic groups may predominantly choose to leave Australia before progressing to senior positions), we repeated the analysis for those respondents who identified themselves as Australian citizens. 177 respondents provided these data. In this cohort, 45% of Australian citizen respondents identified as having North-West European background, 36% Oceanian-Australian, 11% Southern and Eastern European, and 4.5% South-East Asian; these numbers are broadly comparable to the overall respondent cohort. There was a big drop in

North-East Asian respondent percentage, which comprised only 0.5% of the Australian citizens cohort, compared to 3% of the overall respondent cohort.

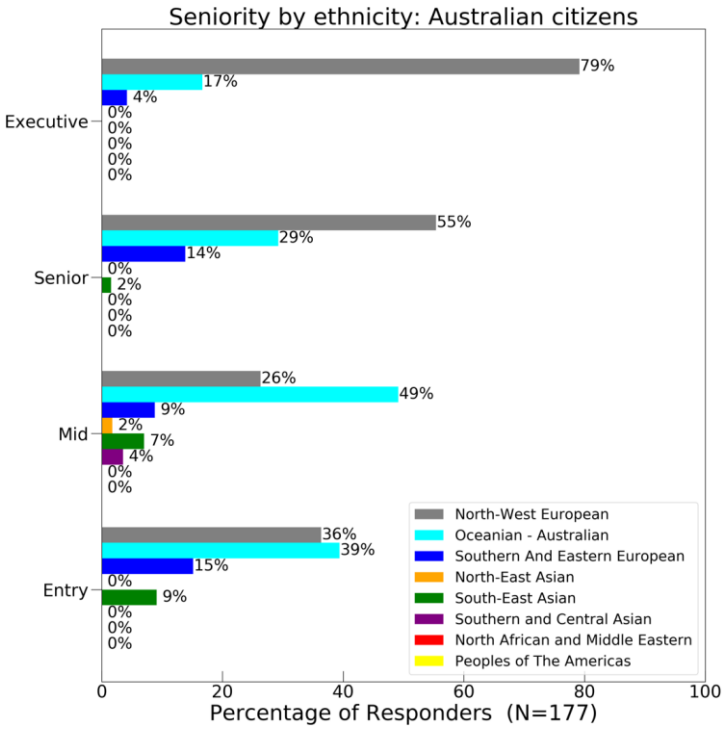

Figure 30: Seniority by cultural and ethnic background for Australian citizens. North-West European and Oceanian-Australian backgrounds are still overrepresented in the most senior positions, while Australians of Southern and Eastern European and Asian heritage are underrepresented in leadership positions.

The trends identified above for all respondents largely remained when only Australian citizens were considered. North-West European and Oceanian-Australian groups were overrepresented at the most senior (executive) levels, comprising 96% of all respondents; while Southern and Eastern European and Asian ethnicities were underrepresented. Only 4% of executives - all of them Southern or Eastern European - came from these ethnic backgrounds, compared to 17% of the total Australian citizen respondent cohort.

These trends mirror findings by the Diversity Council of Australia (https://www.dca.org.au/research/capitalising-culture), who in 2013 surveyed leadership of ASX200 companies and found that senior leaders with Anglo-Celtic and North-West

European cultural origins were significantly overrepresented compared to the overall Australian population: 90.3% of senior executives came from these cultural backgrounds, compared to only 75.7% of the general community.

5.7 Astronomy alumni

20 respondents indicated their employment type as Astronomy Alumnus. Most respondents provided further details in the open comments section, including four who indicated that they are retired astronomers (three from continuing, one from fixed-term positions) who are pursuing active research as emeritus staff. Of the remaining 16 respondents, seven out of 10 men and four out of six women provided reasons for leaving astronomy. 14 of 16 alumni nominated either North-West European or Oceanian-Australian as their ethnic and cultural background, consistent with the broader respondent cohort.

By far the most significant factors identified by alumni as reasons for leaving astronomy were "long term prospects in an astronomy career", indicated by 91% of respondents (4/4 women and 6/7 men); and a partner's career (60% of respondents). Other factors included financial reasons (30%) and parental responsibilities (20%). The overwhelming majority of open-response comments (5 out of 7 of those who provided answers) highlights lack of funding as a reason for their leaving astronomy – suggesting that the long term prospects factor was closely tied to funding. A further respondent commented that "it wasn't my decision"; only one respondent nominated declining interest in astronomy as the reason for the switch. All respondents who provided reasons for leaving had not secured stable positions in astronomy before leaving, instead holding fixed-term (8 respondents), continuing contingent (2) or casual (2) roles. The respondents were overwhelmingly in entry level (55%) or mid-level (33%) roles at the time they left astronomy. Only one respondent nominated astronomy workplace culture as the reason for leaving, along with two other reasons.

While this list of respondents represents a fraction of all astronomy alumni – for example the Astronomical Society of Australia has over 40 Alumni members, and more ex-astronomers are not ASA members – these answers provide useful insights into the reasons for why individuals leave astronomy. Below we compare these to self-reported career barriers by the overall cohort of people in astronomy. While a much smaller fraction of people (typically less than 20%) working in astronomy report retrospective barriers so clearly identified by the alumni, a much larger fraction (over 70%) anticipate career prospects, financial and workplace culture factors to be a significant barrier in the future. The importance of career opportunities and financial considerations are consistent with the lived experience of astronomy alumni who have completed our individual survey. Their experience also suggests that the "two body problem", i.e. the need to accommodate a

partner's career, is likely to emerge as the other important issue for many people currently working in astronomy.

5.8 Self-reported career barriers

Respondents were asked about retrospective and potential career barriers. 379 (68%) of respondents identified at least one potential or retrospective barrier.

The most important factors identified by respondents were career prospects, financial and workplace culture, each important to at least 20% of respondents retrospectively, and at least 70% of respondents prospectively. While partner's jobs and carer's responsibilities were retrospectively important factors to approximately 5% of respondents of less (for each factor), a much larger fraction of respondents (>20%) saw this as being potentially important in the future.

In the open-ended comments section, job security and work-life balance features prominently. We received 11 open-ended responses, eight of which directly mentioned turning down a job because the respondent was not prepared or not in a position to move again, either overseas or interstate.

The STEM Career Pathway (2023) survey asked a slightly different question on perceived career barriers, which encompassed both retrospective and prospective scenarios. Job availability and personal/family circumstances also featured highly in that broader STEM cohort: 35% of the STEM Career Pathways respondents stated that not enough jobs are available in their field, 21% cited personal or family circumstances, and 17% a lack of support after a career break. Hence issues identified by astronomy respondents appear to be ubiquitous across Australian STEM. One recommendation to come out of the STEM Career Pathways was a proposal for longer duration fellowships, to assist with job security.

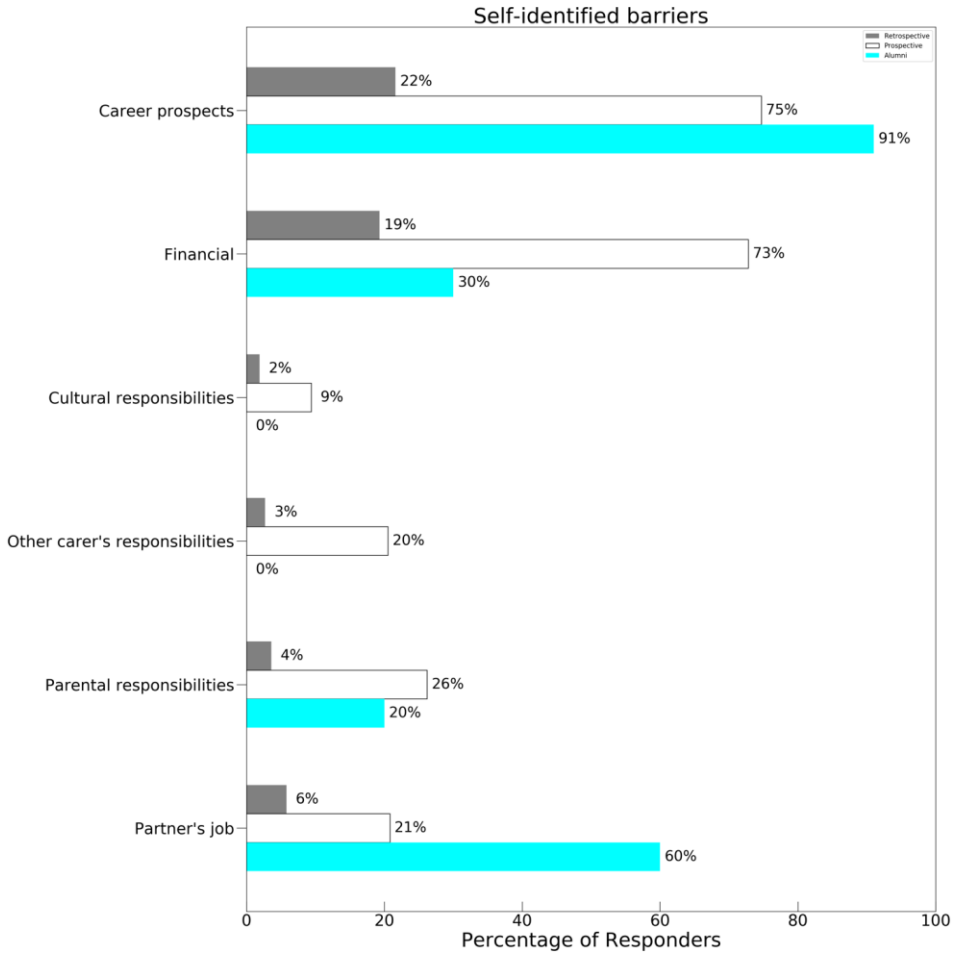

Figure 31: Self-identified career-affecting factors by all respondents (grey, retrospective and prospective) and alumni (cyan).

Appendix A: Institute Contacts

Institute	Primary Contact
CSIRO Astronomy & Space Science (CASS)	Marilena Salvo
Curtin University	Steven Tingay & Tina Salisbury
Macquarie University	Richard McDermid
Monash University	Paul Lasky
Swinburne University of Technology	Michael Murphy
The Australian National University (ANU)	Stuart Wyithe
The University of Adelaide	Gavin Rowell
The University of Melbourne	Rachel Webster
The University of Queensland (UQ)	Holger Baumgardt
The University of Sydney	Marie Partridge & Joss Bland-Hawthorn
The University of Western Australia (UWA)	Shané Kingdon
University of Southern Queensland (USQ)	Brad Carter
University of Tasmania	Andrew Cole
University of New South Wales - Canberra (UNSW-Can)	Ashley Ruiter
University of New South Wales - Sydney (UNSW-Syd)	Sarah Brough
Western Sydney University (WSU)	Miroslav Filipovic

Table A1: The institutional survey responders and primary contacts.

Appendix B: Survey Questions

Questions for the Institute and Individual Survey and the spreadsheet for graduate outcomes are supplied in a separate document.

Decadal_Plan_Individual_Survey_Questions_2024.pdf
Decadal_Plan_Institutional_Survey_Questions_2024.pdf
Graduate_and_Honours_outcomes_Decadal_survey_template.xlsx

Appendix C: Data

The data for all figure and tables are provide in spreadsheet form in two separate documents. The list of email addresses for future surveys of alumni should be held by the AAS in a secure location. A digitized version of the figures and table from 2016 WG 3.1 report is also provided.

WG3.1 Figure Data.xlsx
WG3.1 Table Data.xlsx
Digitised Astronomy Decadal Plan (2016-2025).xlsx
Astronomy_email_address.xlsx