Background and scope

The Physics Equity and Access Committee (PEAC) at the University of Sydney was created in 2014 for the purposes of devising policies and actions to promote equity and accessibility within the School of Physics. Its membership comprises staff and students within the School of Physics split between a 12-member Core Group that includes the Committee’s two co-Chairs, as well as a 21-member Consultative Group. As stated in PEAC’s Terms of Reference:

“The goals of the Committee are to devise policies, priorities and actions for the School of Physics to promote equity of opportunity and access across all areas of the School, to make our work environment supportive of all staff and to actively remove diversity biases, both conscious and unconscious. We aim to implement, monitor and continually improve our programs.”

One of PEAC’s primary goals is to achieve gender equity within the School of Physics. Data compiled from the Department of Education and Training and published by Science in Australia Gender Equity (SAGE) in 2014\(^1\) show that women continue to be underrepresented across STEMM disciplines (Science, Technology, Engineering, Mathematics and Medicine) in Australia, particularly at senior levels (see Figure 1).

To investigate gender imbalances amongst School of Physics staff, PEAC member Chris Herron compiled a report that quantifies the ratios of female professional and academic (levels A through E) staff members between 2003 and 2015\(^2\). Of particular note from this study were the following findings:

- The fraction of female professional staff has increased from \(\approx 30\%\) (2003 – 2010) to \(\approx 50\%\) (2013 – 2015)
- The fraction of female academic staff (all levels) has remained approximately constant at \(\approx 20\%\) from 2003 to 2015
- Contrary to the trend in Figure 1 that showed decreasing female representation at higher academic levels, there was no clear difference between the fraction of female academic staff at each academic level (A through E) in the School of Physics.

The report concluded by noting that any changes to School of Physics hiring and promotion policies over the last decade has neither encouraged nor discouraged more women to pursue academia in Physics as a career. Furthermore, the low

---
fraction of female academic staff in the School of Physics may in fact stem from a similar underrepresentation of female undergraduate Physics students.

In an effort to improve upon the gender imbalance amongst School of Physics staff, PEAC has adopted a set of Local Provisions⁴, which includes setting gender targets of achieving 40% women at level E academic positions and 45% women at level D by the year 2025. Further to this effort, the School of Physics has set the additional target of at least 40% women for new appointments to continuing academic positions. However, since the low fraction of female academic staff may be - at least in part - a consequence of an underrepresentation of female Physics students, PEAC decided to conduct an additional study to quantify the ratios of female undergraduate and post-graduate students in the School of Physics. The scope of this report is therefore to present the results of this investigation.

Historical perspective on gender imbalance in the School of Physics

To gain some insight into how the relative numbers of male and female undergraduate Physics students have evolved over the past several decades, a set of

---

⁴The full set of Provisions may be found at http://sydney.edu.au/science/physics/about/equity.shtml
Table 1: Historical data summarising the average fraction of male and female students enrolled each decade in Physics III and Physics IV between 1951 and 1999.

<table>
<thead>
<tr>
<th>Decade</th>
<th>Physics III</th>
<th>Physics III</th>
<th>Physics IV</th>
<th>Physics IV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
<td>Females</td>
<td>Males</td>
<td>Females</td>
</tr>
<tr>
<td>1950s</td>
<td>0.93</td>
<td>0.07</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1960s</td>
<td>0.95</td>
<td>0.05</td>
<td>0.97</td>
<td>0.03</td>
</tr>
<tr>
<td>1970s</td>
<td>0.93</td>
<td>0.07</td>
<td>0.95</td>
<td>0.05</td>
</tr>
<tr>
<td>1980s</td>
<td>0.88</td>
<td>0.12</td>
<td>0.89</td>
<td>0.11</td>
</tr>
<tr>
<td>1990s</td>
<td>0.84</td>
<td>0.16</td>
<td>0.82</td>
<td>0.18</td>
</tr>
</tbody>
</table>

class photos, which had been archived by the School of Physics and dated as far back as 1951, were analysed by tallying the numbers of male and female students in each photo. Class photos only existed for 3rd and 4th year students (Physics III and IV, or equivalent). In cases where students who were not present for the class photos were identified, these individuals were tallied as either male or female based solely on the name provided and assumptions of traditionally male and traditionally female names. With the exception of years 1991 and 1992, class photos for 3rd year students were available for all years between 1951 and 1999. Class photos for 4th year students were available for all years between 1963 and 1996, with the exception of 1970, 1977 and 1995.

For each decade between 1950 and 2000, the average fraction of male and female students enrolled in 3rd and 4th year Physics is summarised in Table 1. The full set of data, plotted as a function of each year between 1951 and 1999, is shown in Figure 2.

The data presented in Table 1 and Figure 2 show that, on average, the fraction of female students in 3rd and 4th year Physics has increased over the time period between 1960 to 2000. Over this time period, the year 1998 saw the highest fraction of female students in 3rd year Physics at 27% whereas the year 1994 saw the highest fraction of female students in 4th year Physics at 33%.
Figure 2: Historical data showing the fraction of male and female students enrolled in Physics III (upper panel) and Physics IV (lower panel) between 1951 and 1999.
Data acquisition for this study

The data acquired for this study comprised the total number of students who self-identified as male, female or other that were enrolled in courses offered by the School of Physics over the time period between 2002 and 2015. The following lists summarise how this information was organised for undergraduate students (Years 1 through 4) and postgraduate students:

Undergraduate students

- Year 1 - Data collected separately for the following units: EDUH 1017; MRTY 1031, 1026; PHYS 1001, 1002, 1901, 1003, 1004, 1500, 1600, 1902
- Year 2 - Data collected separately for the following units: PHYS 2011, 2911, 2012, 2105, 2013, 2213, 2912, 2913
- Year 3 - Data grouped for all students enrolled in any PHYS 3XXX unit
- Year 4 (Honours) - Data grouped for all students enrolled in Honours

Postgraduate students

- Postgraduate Coursework
- Masters by Research
- PhD

This information was collated by PEAC co-Chair Eve Teran and School of Physics Administrative Assistant Alexis George using SIBI - the University of Sydney’s Strategic Information and Business Intelligence program. SIBI acts as a reporting platform that draws information about student enrolment from Sydney Student, the University’s student administration system. Using SIBI to generate a report for a given University course provides a snapshot of, among other things, the total number of students currently enrolled in that course, along with self-reported gender information for those students. Since the data for this study was acquired retrospectively, information provided by SIBI reflects the numbers of students who remained enrolled in each course up until the end of each semester.

Study findings

Results from this study are presented below and organised into separate subsections according to each year of study considered (undergraduate years 1 through 4 followed by postgraduate Physics).
First year undergraduate physics

Data was collected for first year undergraduate students enrolled in 10 different units (5 each in Semester 1 and 2). Figure 3 shows the fractions of male and female students calculated from the total number of students enrolled in all units for Semesters 1 and 2. There do not appear to be any substantial differences in the fraction of male/female students between each semester. Furthermore, there appears to be little long term change in the fraction of male/female students over the 14 year time period studied, with approximately 60% males and 40% females enrolled in first year physics units.

Figure 4 shows the fraction of female students enrolled in each of the first year physics units studied over the same time period from 2002 to 2015. The most apparent observation from Figure 4 is that there is substantial variation in the fraction of females enrolled in different first year physics courses, ranging between approximately 20-30% for units PHYS 1001, 1003, 1901 and 1902 and approximately 60-70% for units MRTY 1031 and 1036. The fraction of female students enrolled in PHYS 1001, 1002, 1004, 1901 and EDUH 1017 also exhibits a slowly decreasing trend, on average, over this time period.
Figure 4: Fraction of female students in Year 1 Physics enrolled in Semester 1 courses (solid lines) and Semester 2 courses (dashed lines) between 2002 and 2015.

Second year undergraduate physics

Data was collected for second year undergraduate students enrolled in 7 different units (2 units in Semester 1 and 5 units in Semester 2). Figure 5 shows the fractions of male and female students calculated from the total number of students enrolled in all units for Semesters 1 and 2. Similar to the results reported for first year students, there do not appear to be any substantial differences in the fraction of male/female students between each semester. For the second year units, there again appears to be little longterm change in the fraction of male/female students over the time period studied. However, relative to the results reported for first year physics units, the fraction of female students is substantially lower at approximately 20%.

Figure 6 shows the fraction of female students enrolled in each of the second year physics units studied. There is variation in the fraction of females enrolled in each unit compared to the distinct variation shown in Figure 4 for first year units. The fraction of female students enrolled in all courses fluctuates between approximately 10-30%, without any distinct trends noticeable over the time period studied.
Figure 5: Fraction of second year male and female Physics students enrolled during Semester 1 (solid lines) and 2 (dashed lines) between 2002 and 2015.

Figure 6: Fraction of female students in Year 2 Physics enrolled in Semester 1 courses (solid lines) and Semester 2 courses (dashed lines) between 2002 and 2015.
Figure 7 shows the fractions of male and female students calculated from the total number of students enrolled in all third year units for Semesters 1 and 2. These results closely resemble those reported for second year students, namely that there does not appear to be any differences in the fraction of male/female students between each semester and there is little longterm change in the fraction of male/female students over time. Furthermore, the fraction of female students again fluctuate about approximately 20%, which reflects the progression of second year physics students into third year.

Third year undergraduate physics

The fractions of male and female students enrolled in fourth year (Honours) physics for Semesters 1 and 2 are shown in Figure 8. These results differ slightly from those reported for students in second and third years, which presumably reflects the fact that not all third year students will continue into an Honours year. The overall average fraction of female students fluctuates about approximately 30%, however there appears to also be a slightly decreasing trend across the full time period studied towards lower fractions of female students, on average.
Postgraduate physics

Data obtained for postgraduate students in Physics is presented separately for those enrolled in coursework and research programs. Figure 9 shows the fractions of male and female students enrolled in postgraduate coursework programs each year for Semesters 1 and 2. Although there is substantial variation year-to-year, there appears to be a larger fraction of female students enrolled in postgraduate coursework programs on average (ranging between approximately 20-60%) than in second, third and fourth year undergraduate units.

Figure 10 shows the fractions of male and female students enrolled in postgraduate research programs (Masters by research and PhD) each year. Results demonstrate a greater fraction of female students enrolled in PhD degrees (approximately 25%) than in Masters degrees (approximately 10%). There is also greater variation year-to-year in the fraction of female students enrolled in Masters programs. On average, there is no noticeable change in the relative numbers of male and female students enrolled in PhD degrees over the time period 2002 to 2015.
Figure 9: Fraction of postgraduate coursework male and female Physics students enrolled during Semester 1 (solid lines) and Semester 2 (dashed lines) between 2002 and 2015.
Figure 10: Fraction of male and female research students enrolled in Masters by research (upper panel) and PhD (lower panel) Physics courses between 2002 and 2015.