Results of the 2022 ECFA Early Career Researcher survey on career prospects and diversity: Part 1

The ECFA Early Career Researcher (ECR) panel

November 10, 2023

This document presents the outcomes of a comprehensive survey conducted among early career researchers (ECRs) in academic particle physics. Running from September 24, 2022, to March 3, 2023, the survey gathered responses from 760 ECRs. The study aimed to gain insights into the career prospects and experiences of ECRs while also delving into diversity and sociological aspects within Particle Physics research. The survey results are presented in a manner consistent with the survey choices. Where relevant, respondents were allowed to select multiple options, and these selections are duly noted. The document offers insights for the Particle Physics community, providing guidance on enhancing career opportunities, fostering diversity, and addressing sociological dimensions within this field.

Authors (to be added. We will be sure to include any people who were active on this project in the past but are no longer on the panel.)
The ECFA Early Career Researcher's (ECR) Panel: ecfa-ecr-organisers@cern.ch

Contents

1 Introduction

This survey was created in order to comprehensively study the opinions of self-identifying early career researchers (ECRs) who work in academic Particle Physics on their career prospects and experiences within academia, an addition to understanding more about diversity and sociological aspects of particle physics research. A full list of the questions asked in the survey is provided in Appendix A.

The survey was implemented in Google Forms and was distributed widely through:

- ECFA National contacts;
- mailing lists for several collaborations (ATLAS, CMS, LHCb, ALICE, EIC, FCC, Compass+Amber, NA61/SHINE, NA62, Mu2e, CERN);
- national mailing lists of several panelist countries (Belgium, Czech Republic, Netherlands, Switzerland).

It collected 760 responses between the 24th September 2022 and the 3rd March 2023.

The survey was formatted primarily through multiple choice questions. Where an 'Other' category is presented, this was given as a free box for text. Unless otherwise stated, the categories used in the presentation of the results correspond exactly to the choices presented in the survey. For appropriate questions, respondents were allowed to select more than one choice, and this is indicated in the text.

In 'Part 1' of the survey analysis, we present the responses to the questions asked in the survey, either as pie charts, histograms, or text. Where appropriate, responses were grouped into broader categories to have better statistics from which to draw conclusions. In 'Part 2', to come soon! we study correlations between the answers given to different questions, in order to draw more comprehensive conclusions.

2 Demographics of respondents

In Figure 1, the current position of the respondents is illustrated. It shows that the majority of the respondents are PhD students and slightly more than a third are PostDocs or research fellows. The rest is divided amongst the remaining categories. Figure 2 presents the current affiliations of the respondents. It indicates that the majority of respondents work at a University, just under half as many work in a national research institution, and just under half as many again work in an international laboratory. The duration of respondents' current contracts are shown in Figure 3. The dominant durations are 36-47 months and 24-35 months.

The current countries of employment and of residence, grouped into geographical regions (see Appendix B for how these groups were defined), are presented in Figs. 4 and 5. From both figures, we see that Northern Europe constitutes the majority of the answers, followed by Mediterranean and Eastern Europe. The nationalities of the respondents are grouped into geographical regions in Figure 6. Around one third of the respondents are Mediterranean, and around another third are from Northern Europe. A fifth are from Eastern Europe, and remaining regions are each represented by a very small fraction of respondents.

In Figure 7, the gender the respondents identify with is illustrated. More than a half of the respondents identify as a cisgender male, almost a third as a cisgender female and a much smaller group identify as a transgender, non-binary or other-gendered person. A small percentage of respondents preferred not to answer. The age of the respondents is shown in Figure 8. Almost half of the respondents are aged between 26 and 30. Respondents aged between 31 and 35 or between 21 and 25 years old each correspond to slightly more than a fifth. Few respondents either lie outside these ranges or didn't want to answer.

In this section, three questions are investigated in two-dimensional plots, concerning the nationality, country of residence and country of employment of the respondents. In Figure 9, the place of work and the nationality are studied. The x and y axes are chosen such that they both contain the same countries, which means that it could happen that a whole row or a whole column remains empty. But this choice allows the matrix to be more understandable, as the diagonal elements represent the same country. Again, in order to ease the readability of the general matrix, the same question is treated in Figures 10 and 11, but the rows and columns containing more than 5 and 10 answers respectively are considered. The plots highlights that the nationality of the respondent doesn't necessarily match the place of work. For example, Switzerland or Germany are showing a more diverse set of nationalities than Italy or Spain.

In Figures 12 - 14, the place of residence and the nationality are studied. The same process to ease the readability of the matrix is applied as the one described for Figures 9 - 11, which highlights some

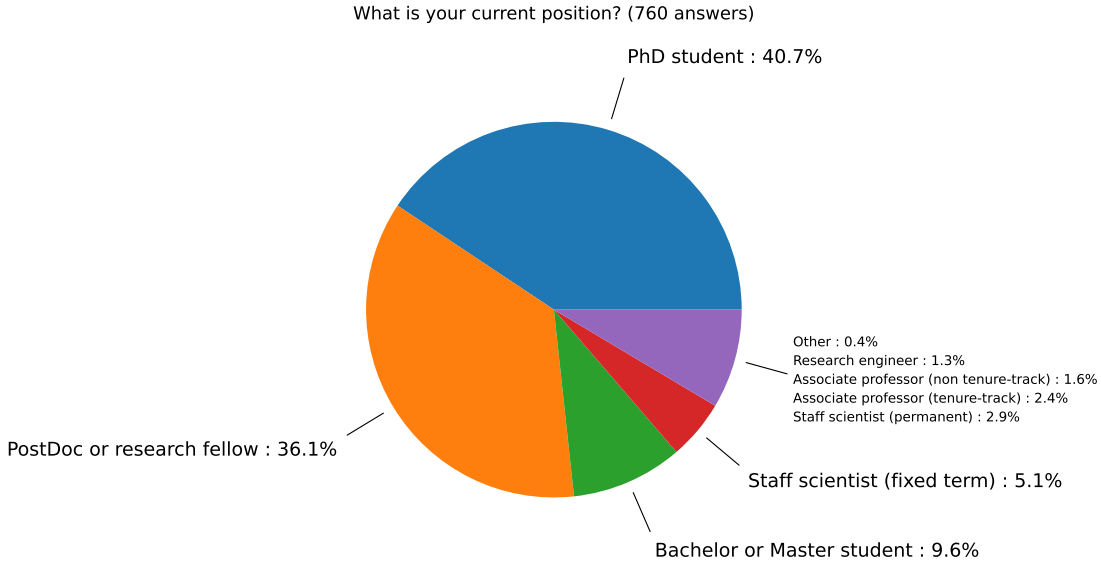

Figure 1: (Q1) Pie chart showing respondents' current position.

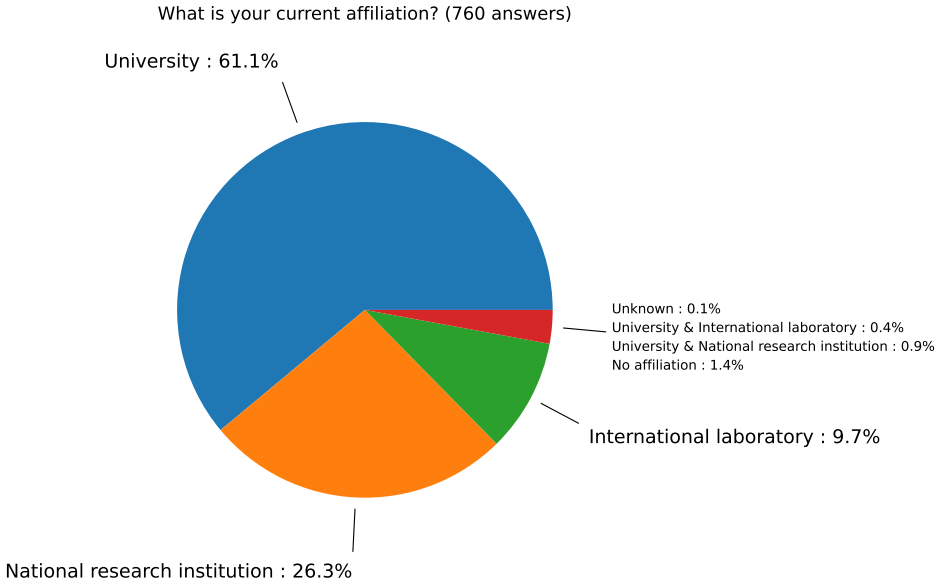

Figure 2: (Q2) Pie chart showing respondents' current affiliation.

differences between the two sets of questions. It seems that for France for example, up to 15 respondents having a French nationality are residing in France, but are not employed by France. On the other hand, for the United States, 12 respondents having an American nationality are employed by the US but are not residing in the US.

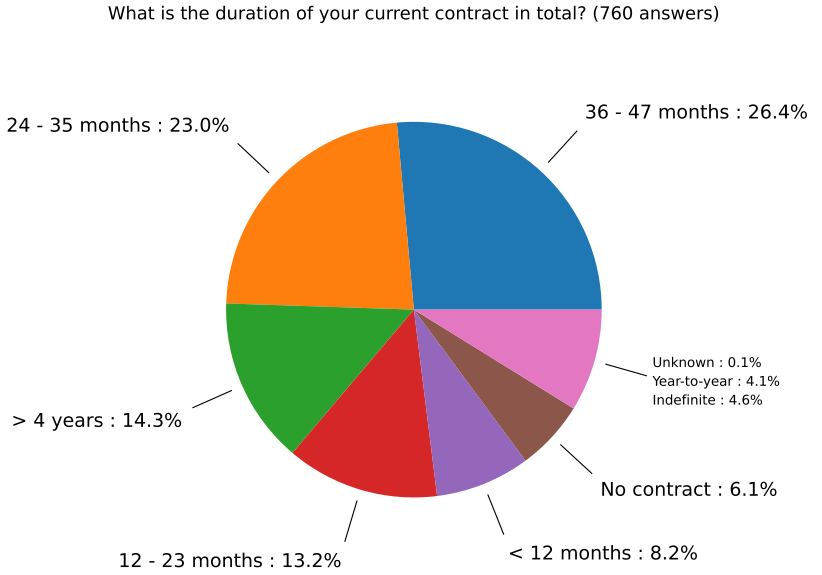

Figure 3: (Q3) Pie chart showing the duration of respondents' current contracts.

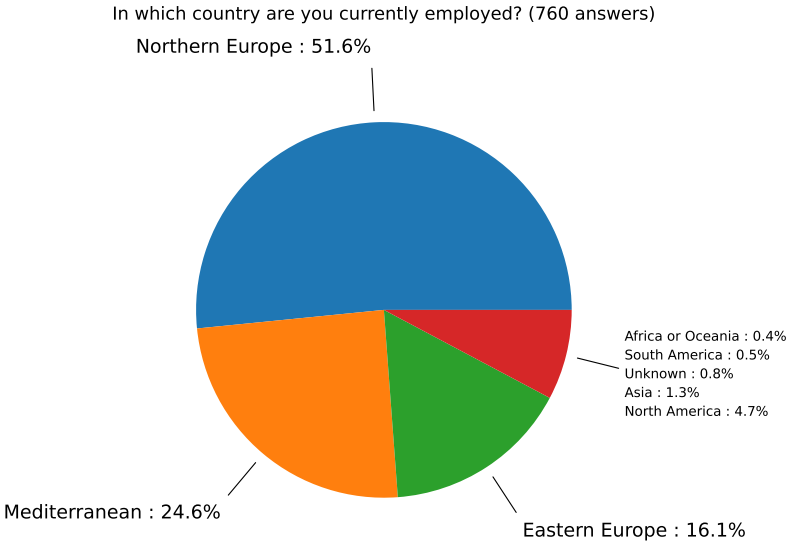

Figure 4: (Q4) Pie chart showing respondents' current country of employment.

In Figures 15 - 17, the place of residence and the the place of work are studied. Once more, the same process to ease the readability is applied as in the previous plots. This set of plots highlights the fact that most of the respondents reside in the country in which they are employed, except for a couple of countries. For example, 61 respondents residing in France are employed in Switzerland where only 23

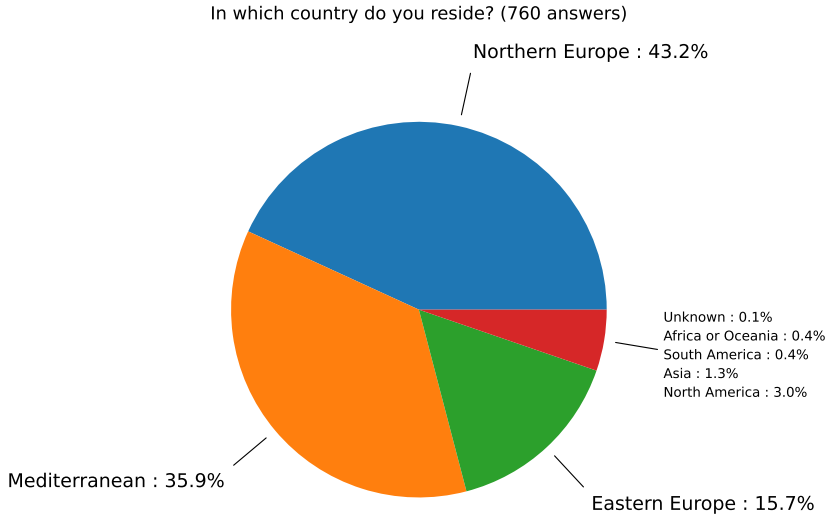

Figure 5: (Q5) Pie chart showing respondents' current country of residence.

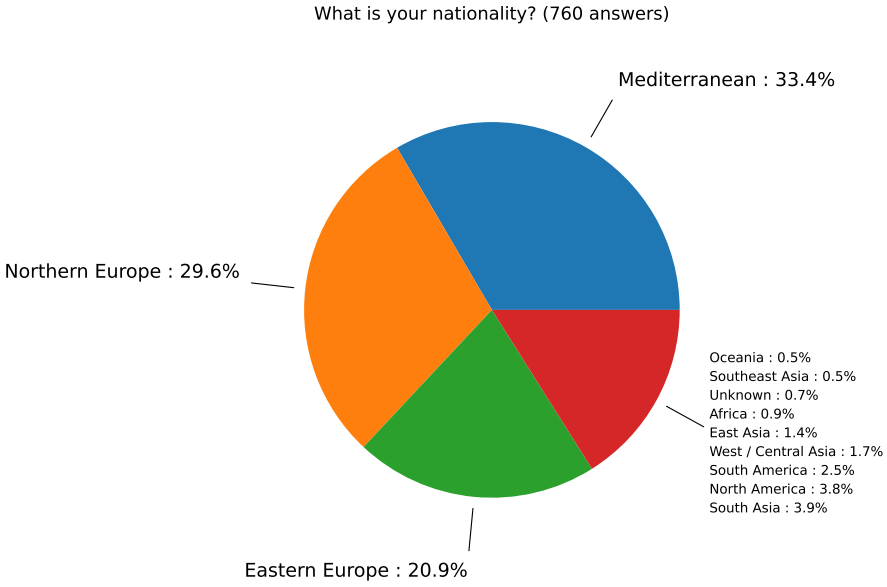

Figure 6: (Q6) Pie chart showing respondents' nationality

respondents are employed in France. For the US, almost a half of the respondents (5 + 8) are either residing in France or Switzerland while being employed by the US where 15 respondents are residing in the US.

Finally, we focus on the the 26% of participants who identify as being part of an under-represented

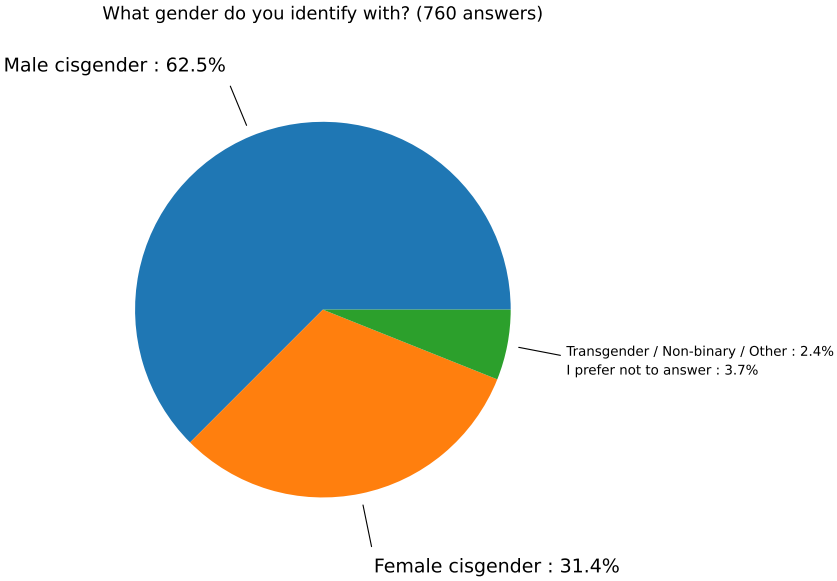

Figure 7: (Q7) Pie chart showing what gender respondents identify with.

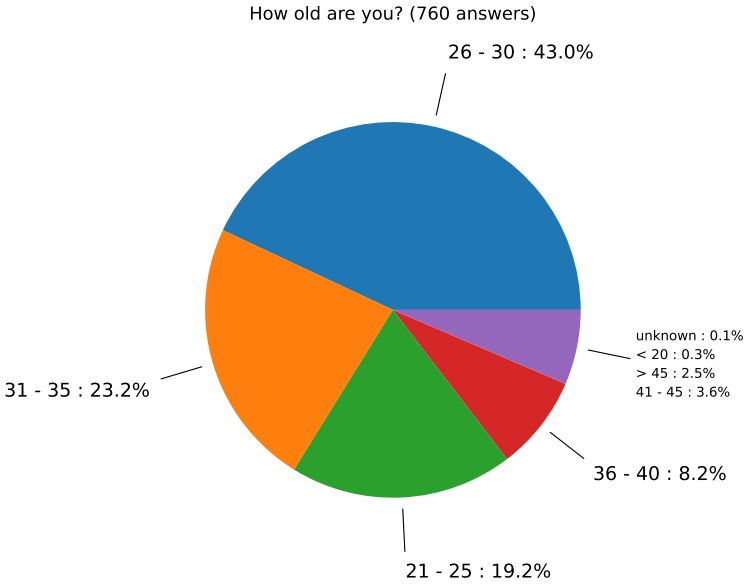

Figure 8: (Q8) Pie chart showing how old respondents are.

group. Figure 18 presents the criterion through which respondents identify as under-represented. More than one category could be selected. Over 60% state this is due to gender. The next two largest criteria are ethnicity and sexual orientation. Within the 'Other' category, 54% are under-represented due to socio-economic background, and the remainder due to religion or political views.

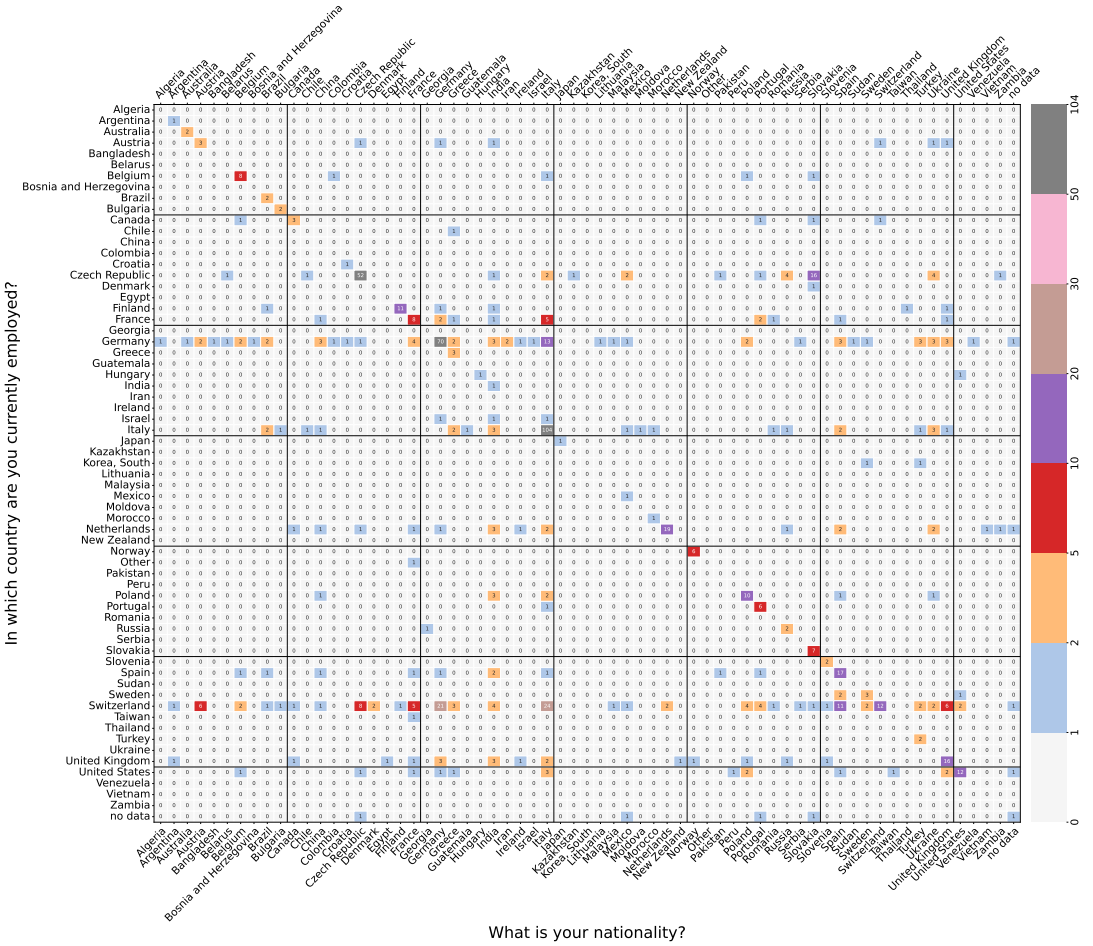

Figure 9: (Q4v6) Correlations between respondents' current country of employment and nationality.

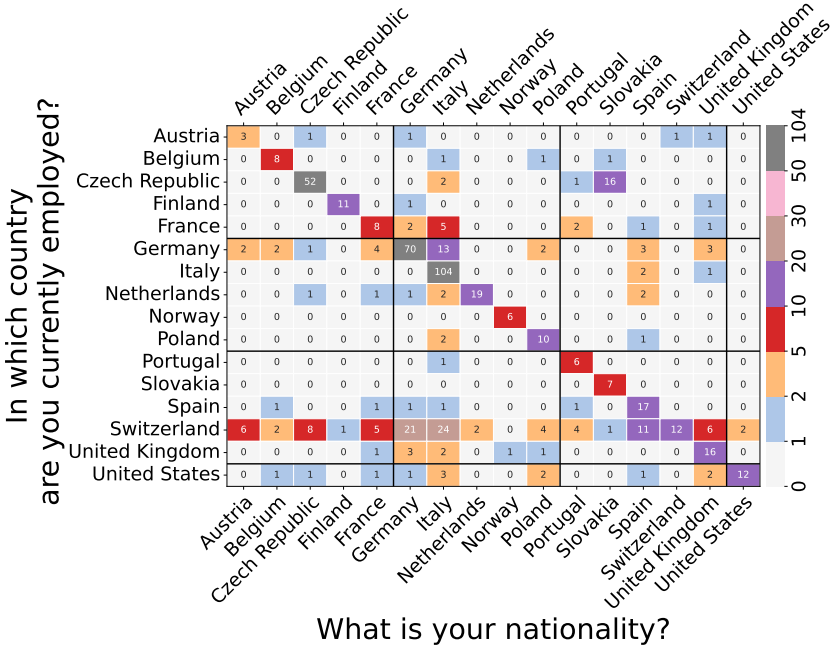

Figure 10: (Q4v6) Correlations between respondents' current country of employment and nationality, for categories with at least 5 responses.

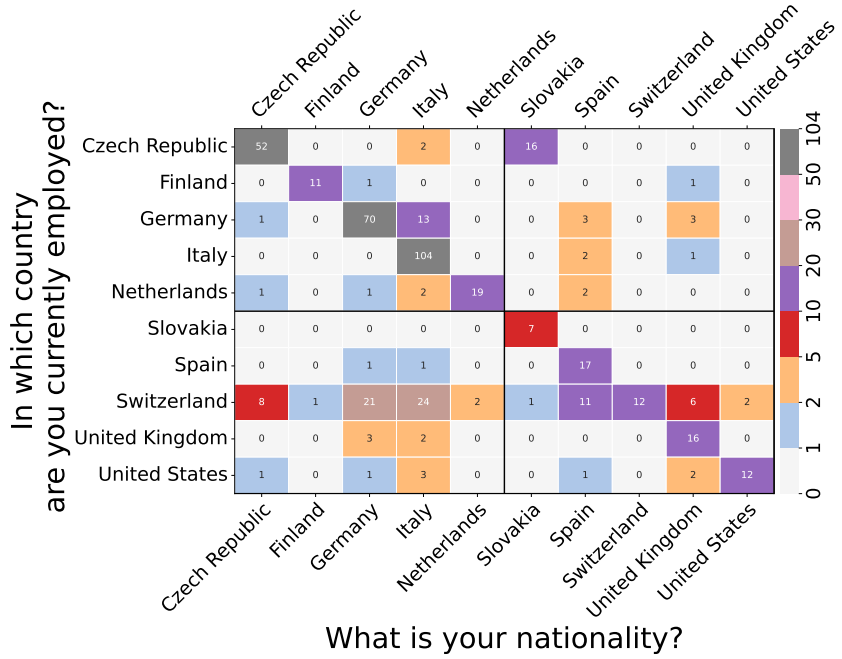

Figure 11: (Q4v6) Correlations between respondents' current country of employment and nationality, for categories with at least 10 responses.

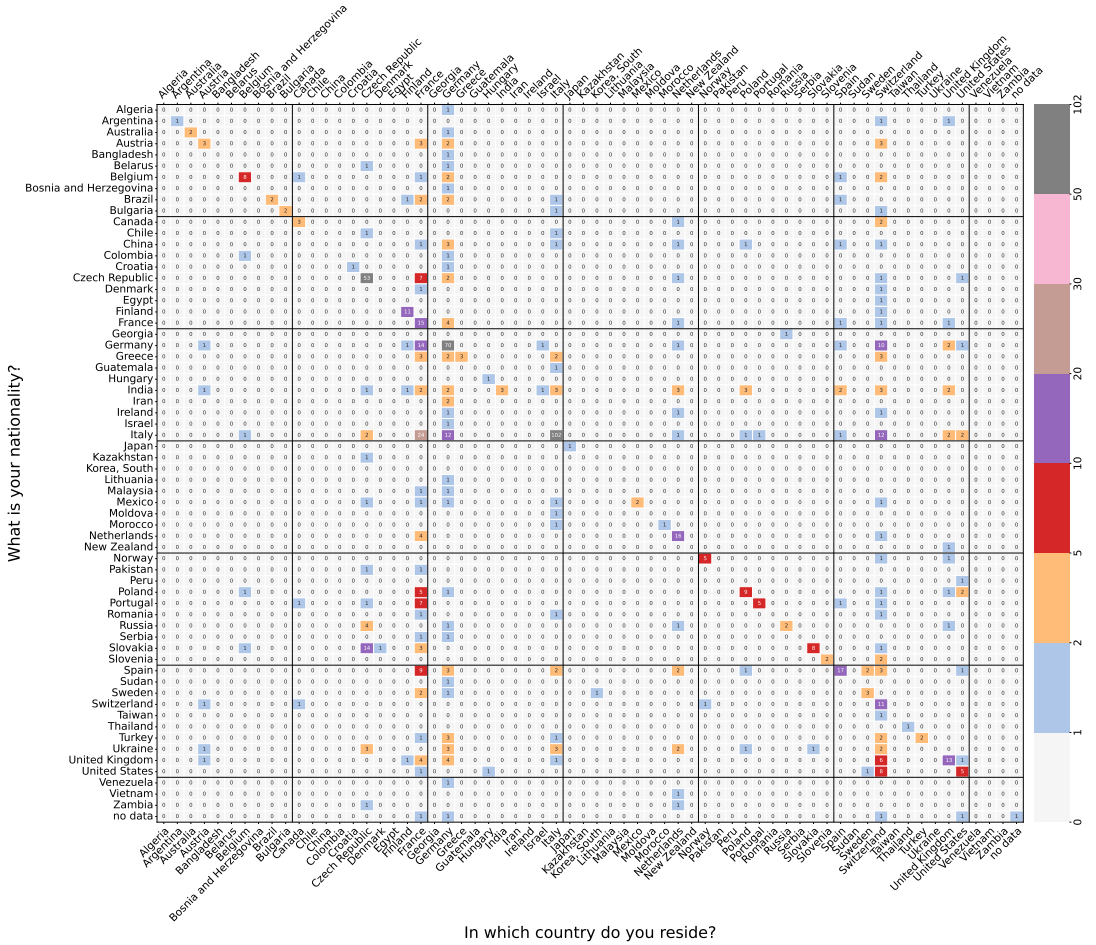

Figure 12: (Q6v5) Correlations between respondents' current country of residence and nationality.

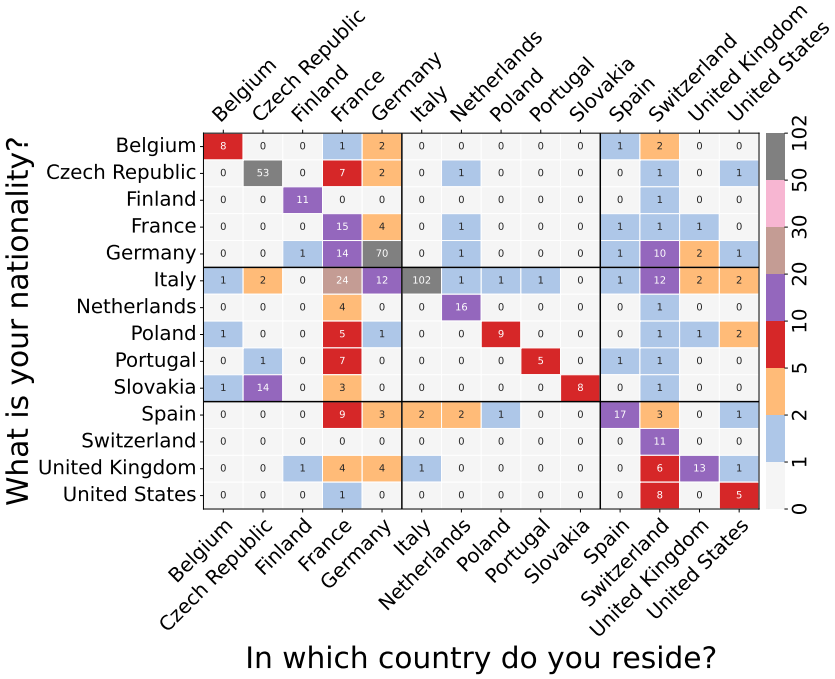

Figure 13: (Q6v5) Correlations between respondents' current country of residence and nationality, for categories with at least 5 responses.

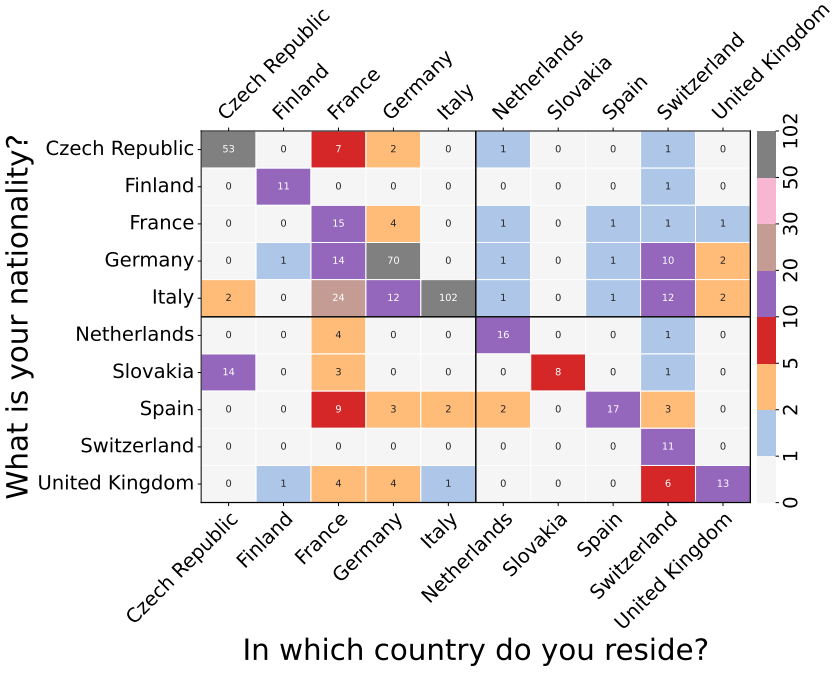

Figure 14: (Q6v5) Correlations between respondents' current country of residence and nationality, for categories with at least 10 responses.

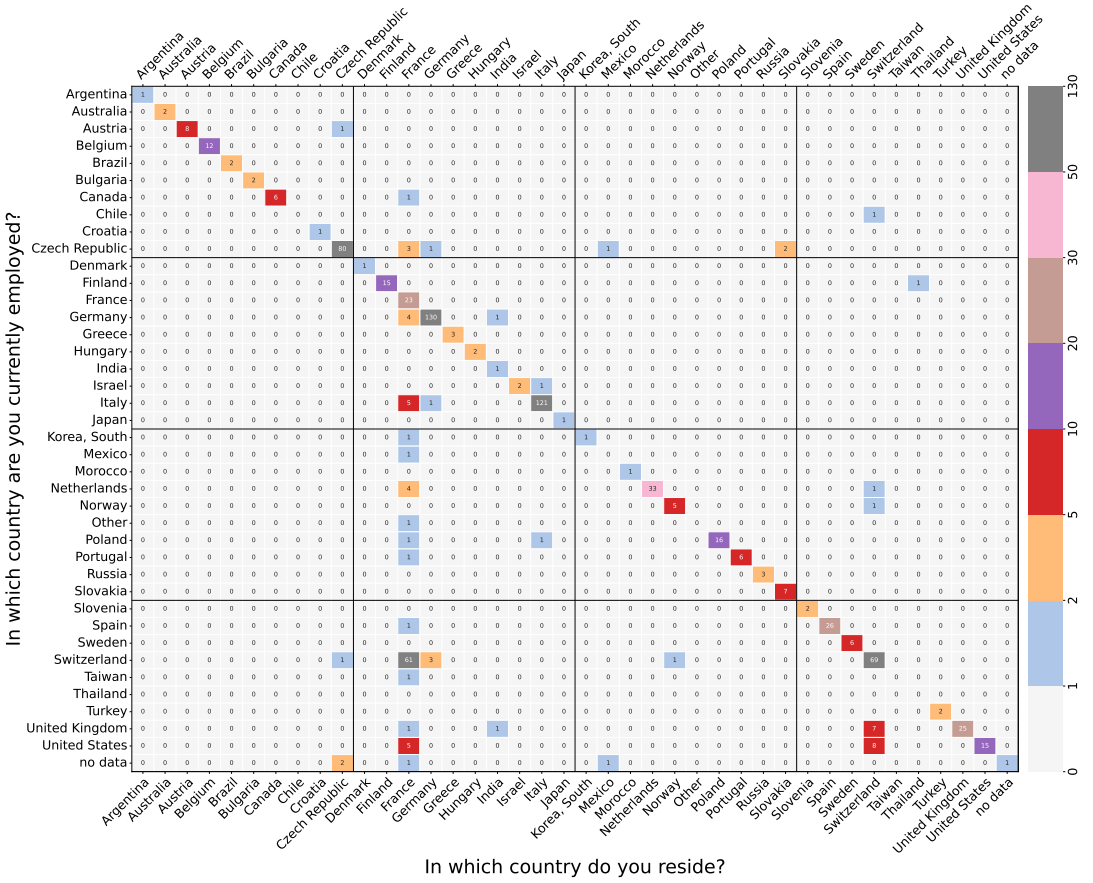

Figure 15: (Q4v5) Correlations between respondents' current countries of employment and residence.

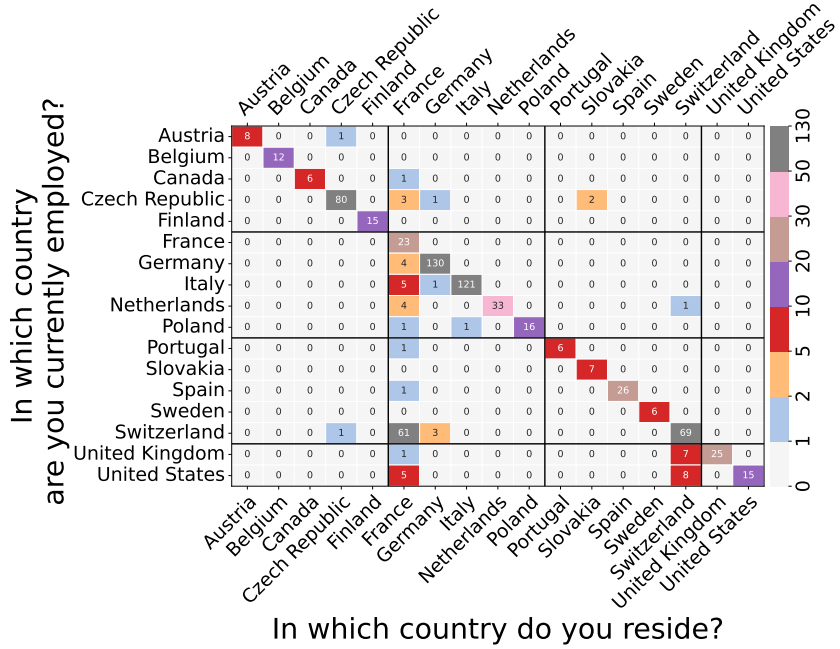

Figure 16: (Q4v5) Correlations between respondents' current countries of employment and residence, for categories with at least 5 responses.

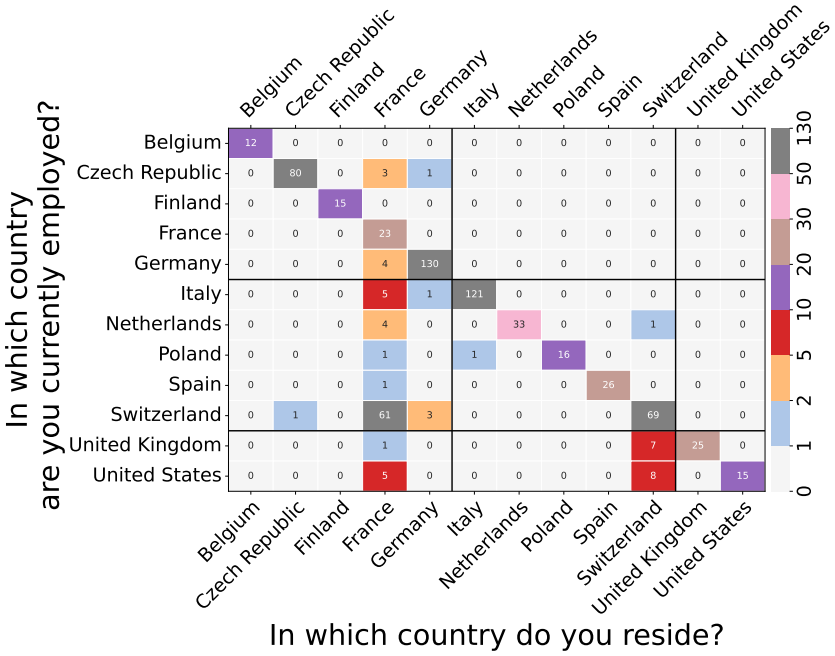

Figure 17: (Q4v5) Correlations between respondents' current countries of employment and residence, for categories with at least 10 responses.

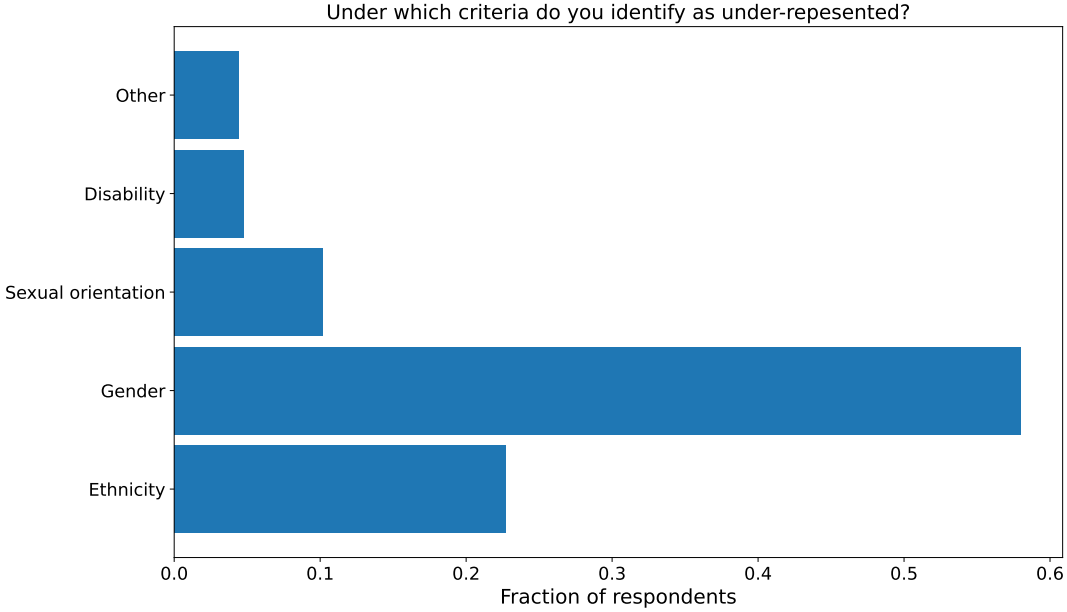

Figure 18: (Q10) Fractions of under-represented respondents who identify as under-represented under each category. Multiple options could be selected per-respondent.

3 Field of work

In this section we present the responses to survey questions concerning the field of work. The primary field of research of the respondents is illustrated in Figure 19. Almost half of the respondents have a primary field of research related to data analysis (43.2%). Theory and phenomenology represent together approximately a fifth of the respondents, which is similar to the proportion who work primarily in detector or accelerator physics (19.1%). Out of the 'other' category, 31% work with astrophysics and cosmology, 21% work in nuclear or atomic physics, 15% in Optics, 13% in other experimental physics, 13% in medical physics or biophysics, 5% in engineering and 3% in IT.

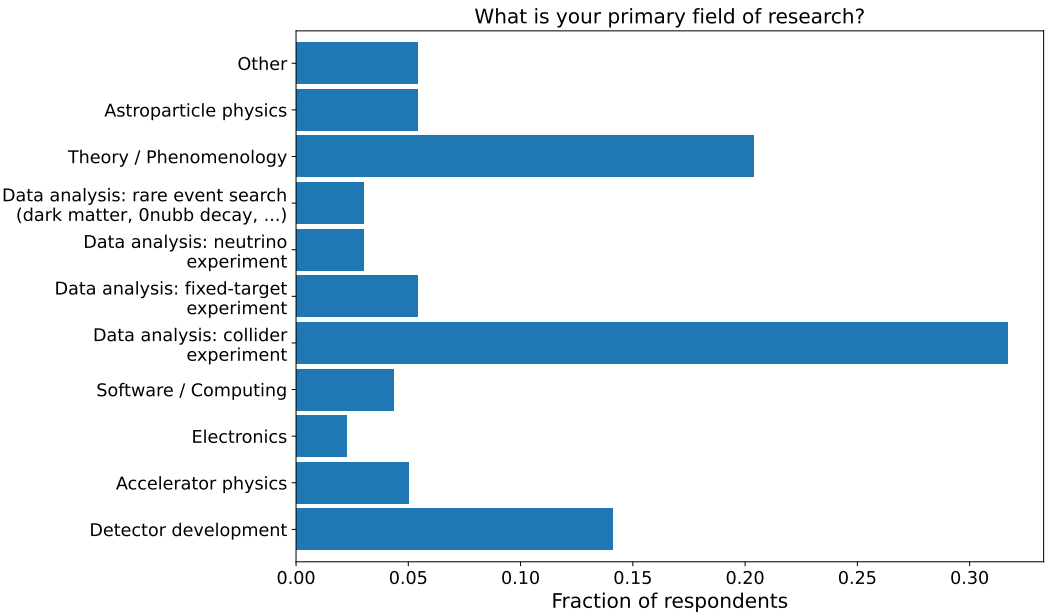

Figure 19: (Q11) The primary field of research of all respondents.

The majority of participants are not involved in an additional field of research, as shown in Figure 20 (where multiple answers were possible). For those that are, dominant additional fields are software/computing, detector development or theory/phenomenology.

75% of respondents work on one experiment, and 1.4% indicated that they work on more than one. For participants working on an experiment, the status of the experiment is shown in Figure 21. Final version of this plot Julia WIP Over 50% of participants are working on a running experiment.

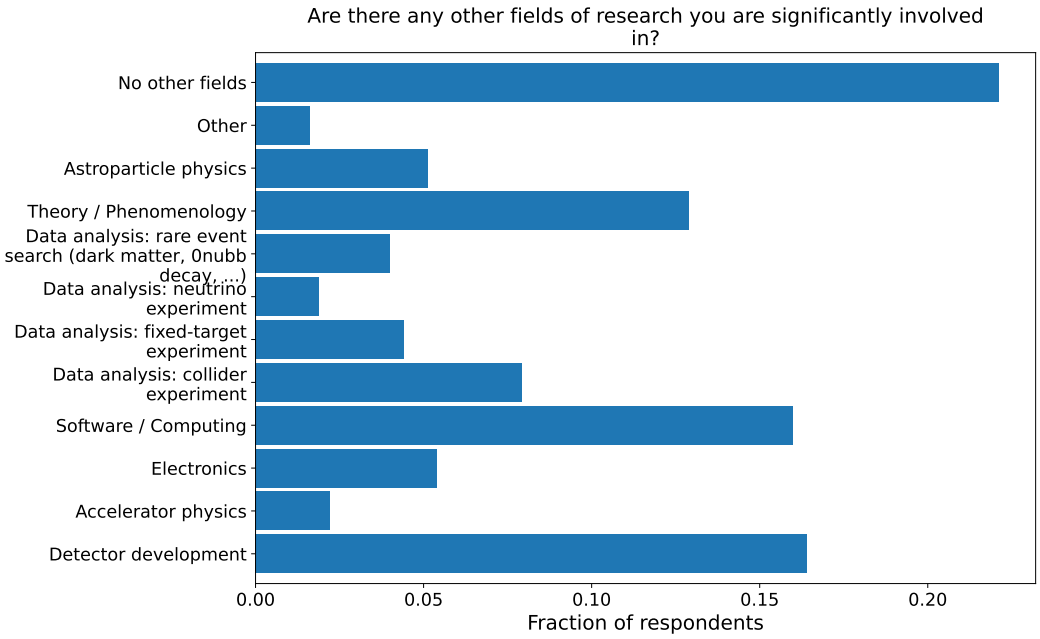

Figure 20: (Q12) Other fields of research that participants are significantly involved in. Multiple answers were allowed per respondent.

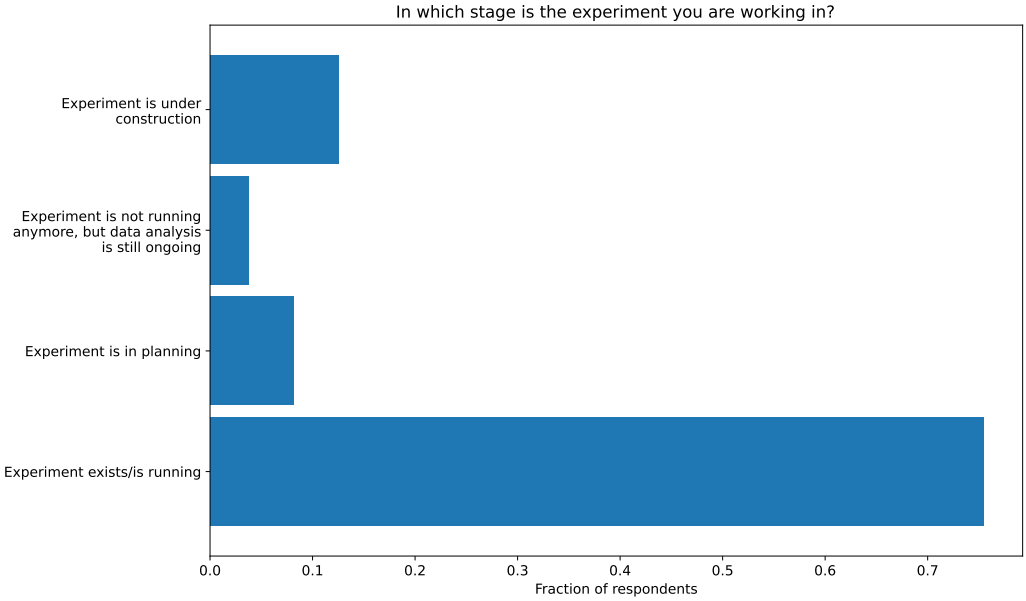

Figure 21: (Q13) The status of the experiments respondents are working on. Fractions are given out of respondents working on an experiment.

4 Work within a research group or collaboration

In this section, we present the results of survey concerning work for a research group or collaboration. For this survey, "research group" is defined as a group of researchers that work together on a daily basis, share the lab and/or office space, and have the same PI(s) and affiliation. Furthermore, "collaboration" is defined as a set of ≥ 2 groups from different institutions in different cities, countries or continents that work together towards a common scientific goal, which could be a new measurement, the development of a new detector, or a new theory.

Participants were first asked if they belong to a research group and/or a collaboration. The majority of participants belong to both with over 50% of responses. Approximately 10% of participants do not

belong to either.

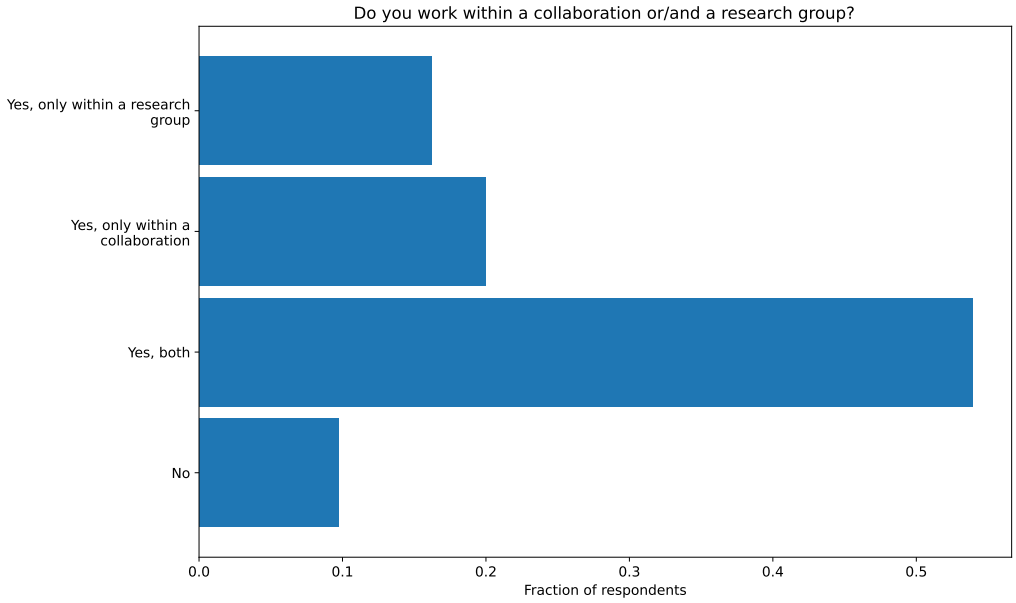

Figure 22: (Q14) Status of respondents' work within a collaboration or/and a research group.

4.1 Research groups

The size of the research group is illustrated in Figure 23. We observe that the smaller the group, the greater the response fraction. Indeed, the biggest fraction of respondents, which amounts to almost 40%, are part of a small research group, composed of 2–5 people. Approximately 10% work in a research group of more than 20 people.

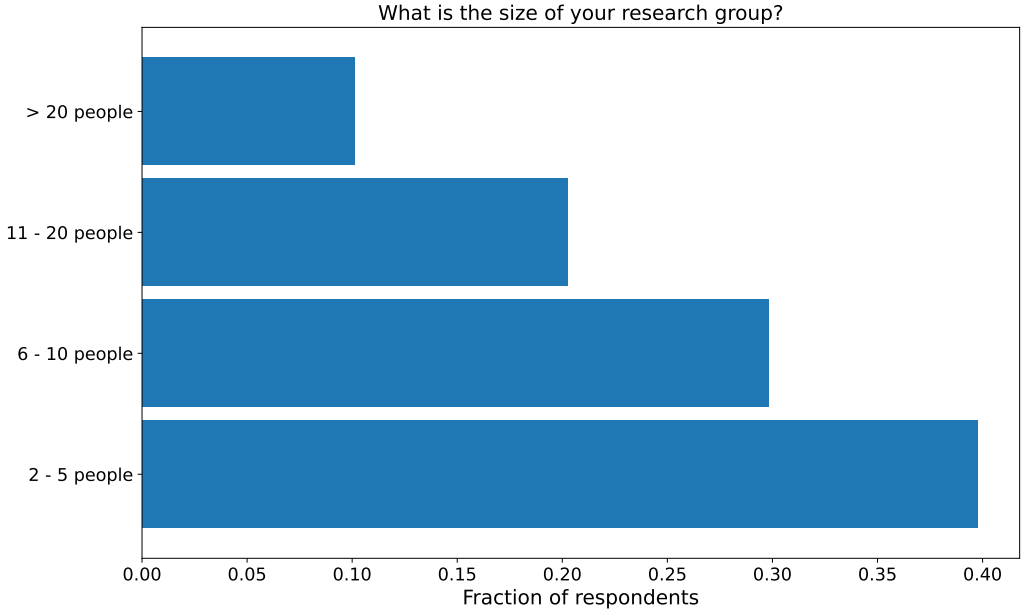

Figure 23: (Q15) Respondents' research group size. Fractions are given out of all respondents who are part of a research group.

The number of people with whom the respondent actively work during a normal week is given in Figure 24. The majority of respondents in a research group work with 0–5 people, which corresponds

to more than 80%. The second largest fraction of the respondents, which amounts to roughly 10%, are actively working with 6–10 people. The remaining fraction is split equally among the two last answers that consider groups of more than 11 people.

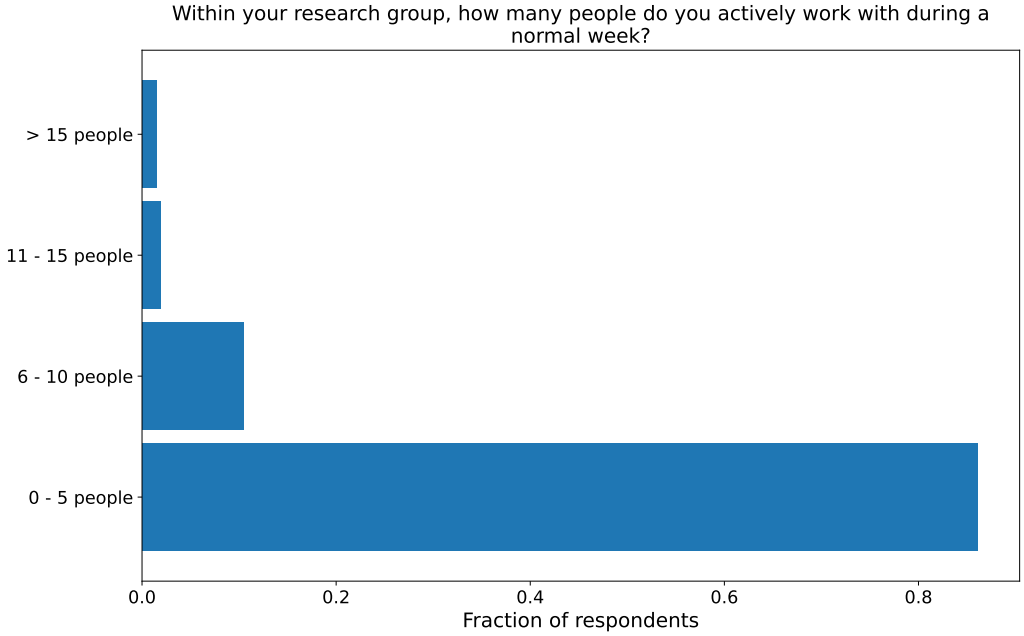

Figure 24: (Q16) The number of people in their research group with whom respondents actively work, during a normal week. Fractions are given out of all respondents who are part of a research group.

The aspects of work in research group are given in Figure 25. The respondents generally view their work as useful to improve their knowledge, skill and expertise. They are positive about their ability to express and realise their original / new ideas within the research group. Respondents view their work in the research group as not too focused on their own research and therefore do not feel isolated from the other research aspects of the whole project. They view rather positively their ability to impact decision-making of the research group. Respondents do not seem to struggle obtaining resources, and their work-life balance within the research group is somewhat healthy.

The visibility by working in the research group is treated in Figure 26. Respondents are generally satisfied with their visibility within their research group. They feel less strongly about visibility outside their group but the response is still positive.

Views on how working in a research group affects respondents' job prospects are presented in Figure 27. Respondents are somewhat positive about their ability to get job opportunities in similar groups, but neutral about their job opportunities in other groups. Respondents are weakly negative about their ability to reach a permanent position within academia but neutral about their prospects outside of it.

The results of the questions related to the service work done for the research group are illustrated in Figure 28 and Figure 29. Almost one third of the respondents, who are in a research group, spend less than 10% of their time doing service work for the group. The two other main fractions are distributed between 10 to 19% and 20 to 29%. More respondents do no service work at all than do it for more than half of the time.

The respondents generally agree that the time spent doing service work for the research group is adequate. They generally agree that their service work is well-recognised, but agree less strongly that it is useful for their careers.

4.2 Collaborations

In this section we present results of the survey questions which concern work as part of a collaboration.

The largest fraction of respondents who are in a collaboration are part of large collaborations with > 500 people, as shown in Figure 30. The distribution of respondents in collaborations of size < 500 are fairly uniform. Although a significant portion of the respondents reported that they are part of a large collaboration with more than 500 people, Figure 31 shows that most respondents actively work

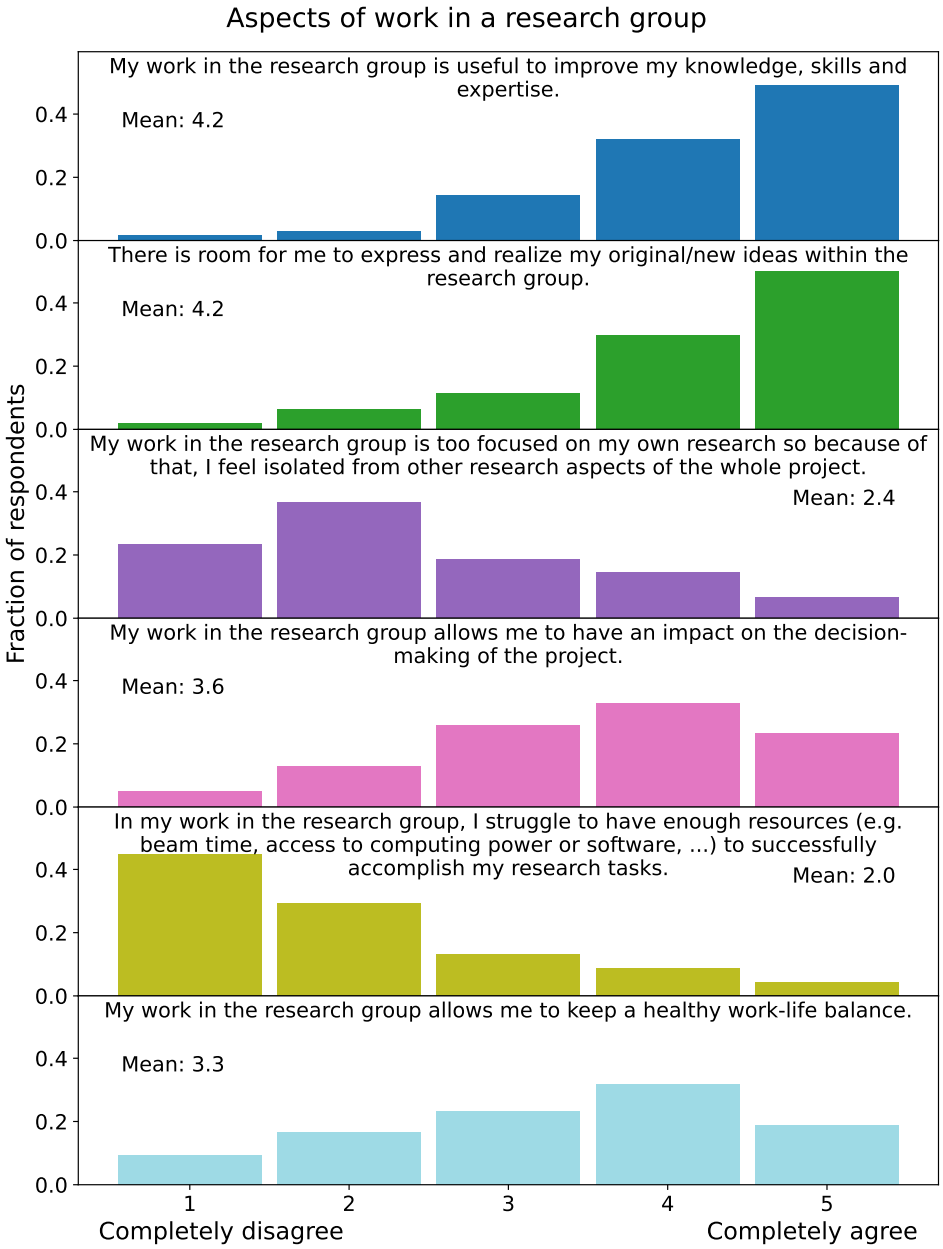

Figure 25: (Q17-22) Aspects of respondents' work in their research group. Fractions are given out of all respondents who are part of a research group.

with $0-5$ people during normal week within their collaboration. Most of the respondents consider their collaboration to be large, as Figure 32 shows, correlating to the answers to previous question.

Several aspects of the work respondents do in collaborations are summarised in Figure 33. The work is generally viewed as useful for improving one's knowledge, skills and expertise. Furthermore, respondents are positive about their ability to express and realise their original/new ideas within their collaboration but less so than in their research group. Respondents reported that their work in the collaboration is not too focused on their own research, implying that they do not feel isolated from other research aspects of the whole project. On the other hand, respondents are more negative about their ability to impact decision-making of the collaboration, more so than in their research group. Respondents generally do not have to struggle to have enough resources to successfully accomplish their research task within the collaboration. Finally, there was no strong opinion about the collaboration allowing respondents to maintain a healthy work-life balance.

Visibility achieved by working in the collaboration is presented in Figure 34. Respondents are gene-

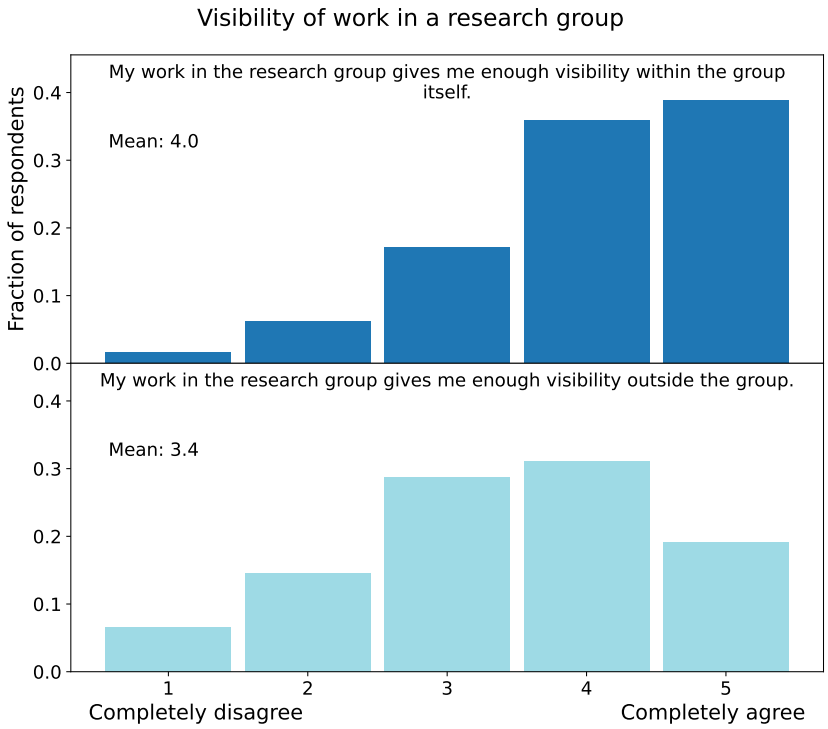

Figure 26: (Q23-24) Visibility of respondents due to work within their research group. Fractions are given out of all respondents who are part of a research group.

rally satisfied with their visibility within the collaboration itself, however they are generally dissatisfied with their visibility outside of their collaboration. There is more disagreement than in answers to analogous questions concerning visibility related to their research group.

Responses to questions about job prospects in relation to collaboration work are summarised in Figure 35 and show similar behaviour to the responses about their research groups. Respondents are weakly positive about their ability to get job opportunities in similar groups, but neutral about their job opportunities in other groups. Respondents are weakly negative about their ability to reach a permanent position within academia but neutral about their prospects outside it.

The majority of respondents who are part of a collaboration reported spending $\leq 20\%$ time doing service work for the collaboration, as we show in Figure 36. Only $\sim 10\%$ of respondents do no do service work for a collaboration at all and, on the other hand, only $\sim 10\%$ report spending more than 50% of their time doing some service work.

Other aspects of service work are summarised in Figure 37. Overall, respondents feel somewhat positive about the amount of time they spent doing service work in their collaboration, how well-recognised it is, and how useful it is for their careers. However, there is more disagreement than in the analogous questions relating to research group.

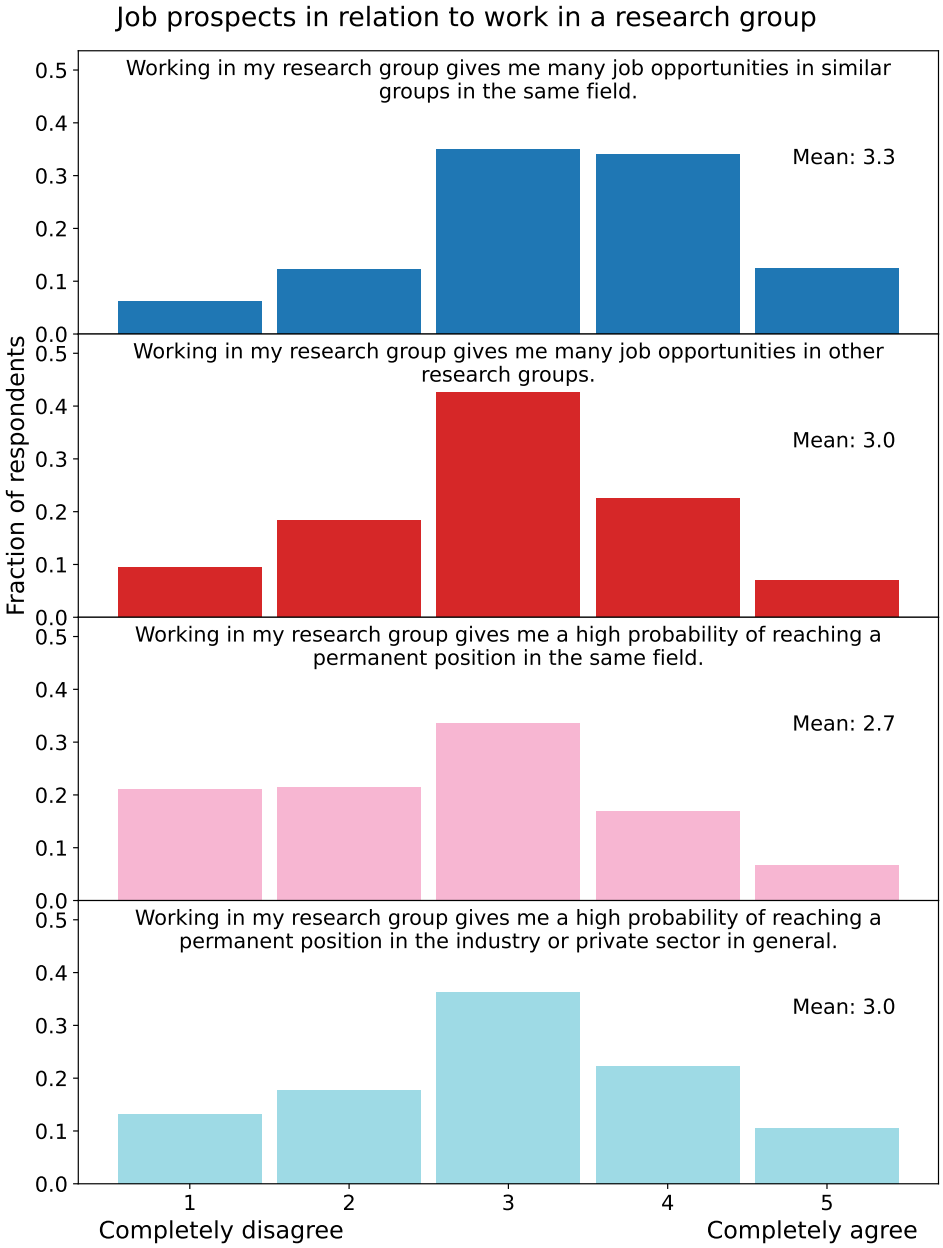

Figure 27: (Q25-28) Respondents' views on how work in their research group affects their job prospects. Fractions are given out of all respondents who are part of a research group.

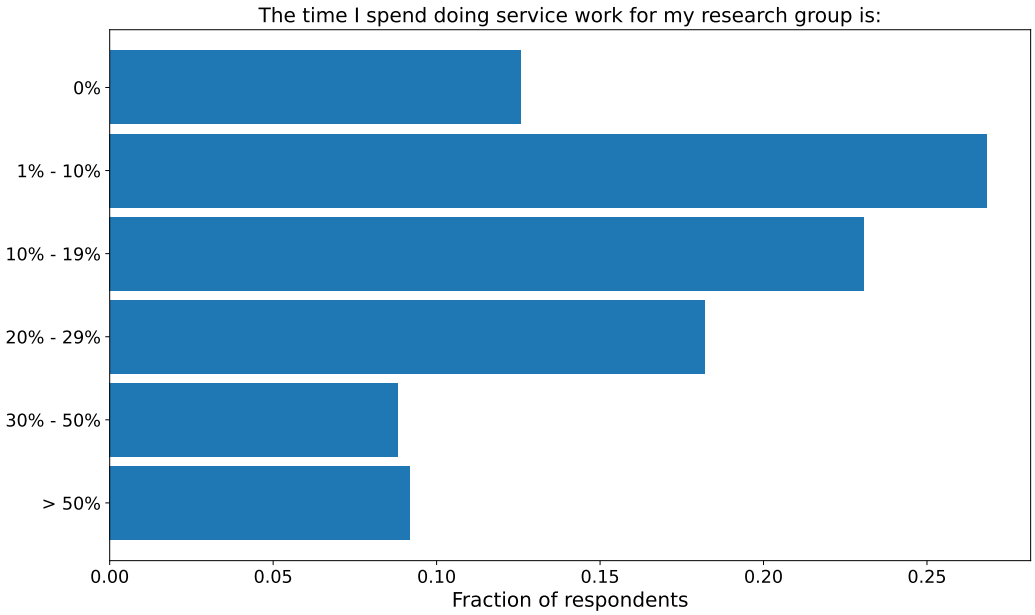

Figure 28: (Q29) The time respondents spend doing service work for their research group. Fractions are given out of all respondents who are part of a research group.

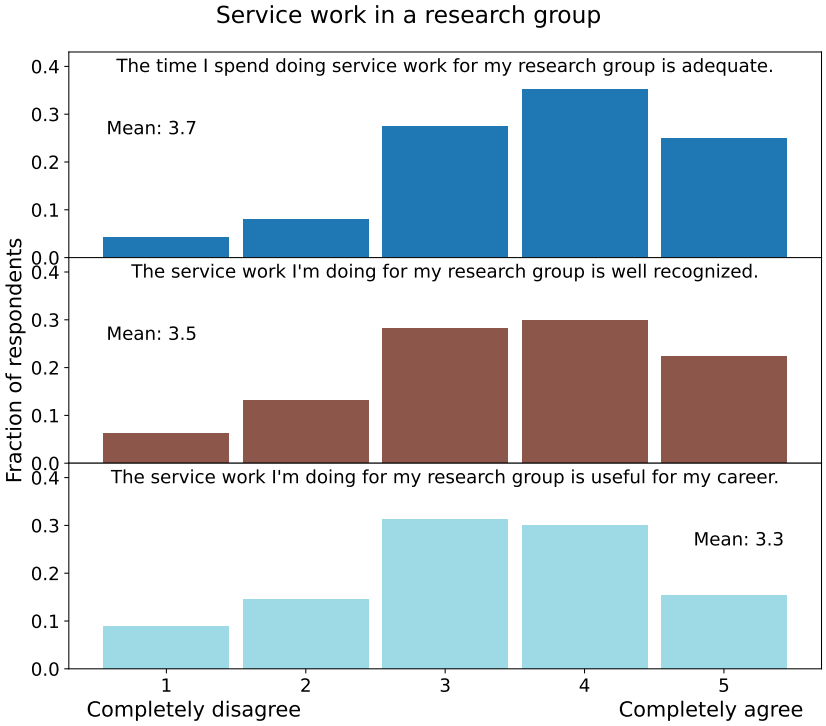

Figure 29: (Q30-32) Respondents' views on the service work they do for their research group. Fractions are given out of all respondents who are part of a research group.

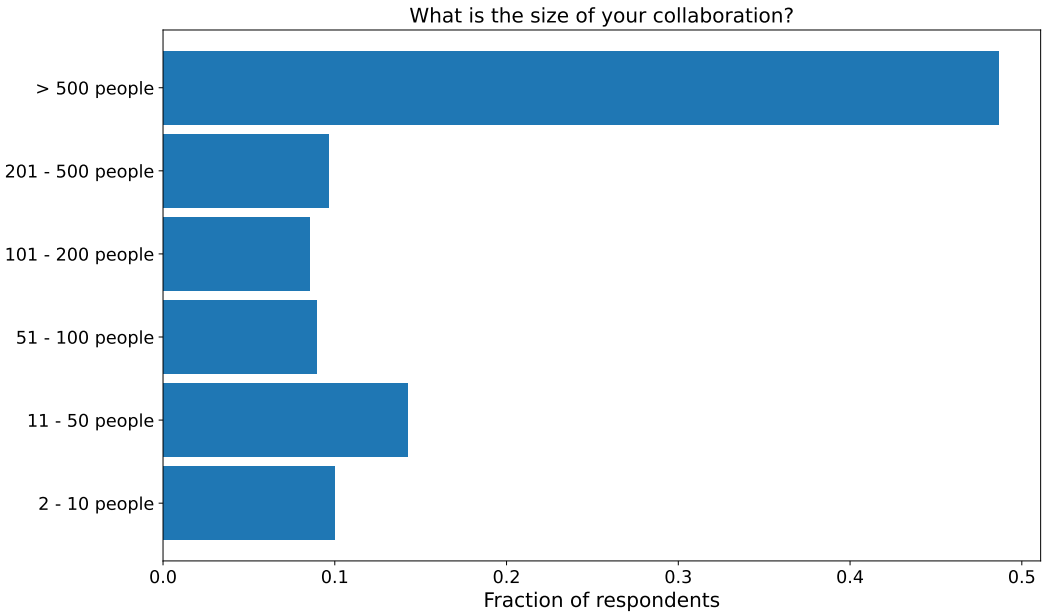

Figure 30: (Q33) Respondents' collaboration size. Fractions are given out of all respondents who are part of a collaboration.

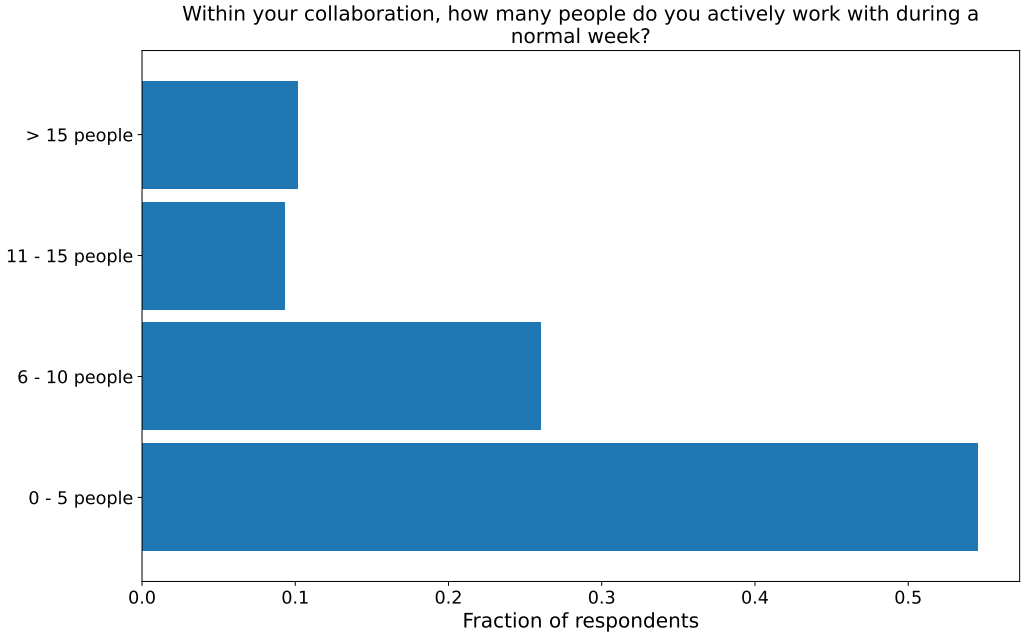

Figure 31: (Q34) The number of people in their collaboration with whom respondents actively work, during a normal week. Fractions are given out of all respondents who are part of a collaboration.

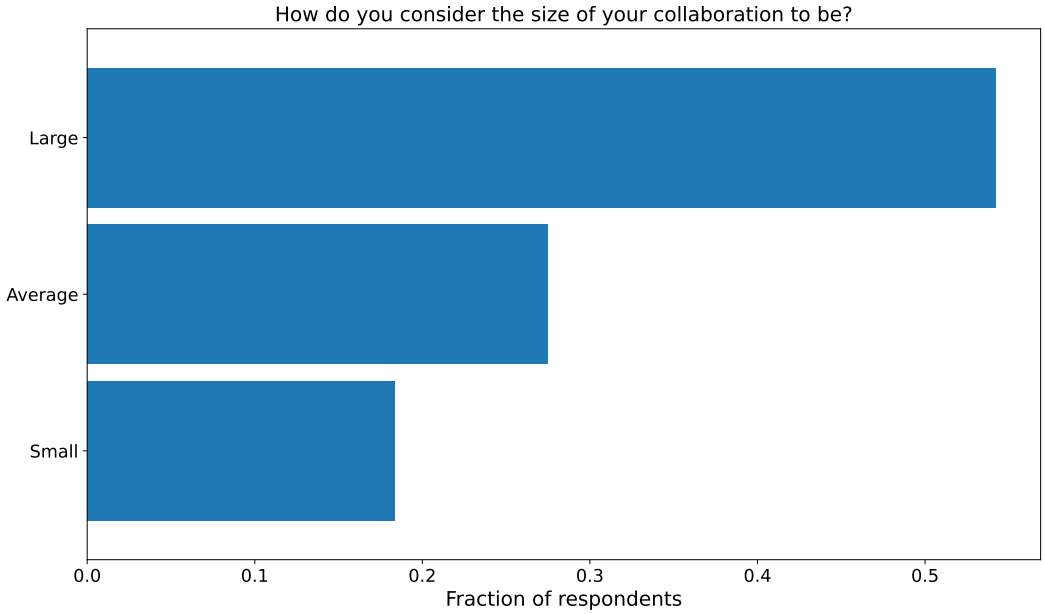

Figure 32: (Q35) Respondents' opinions on the size of their collaboration. Fractions are given out of all respondents who are part of a collaboration.

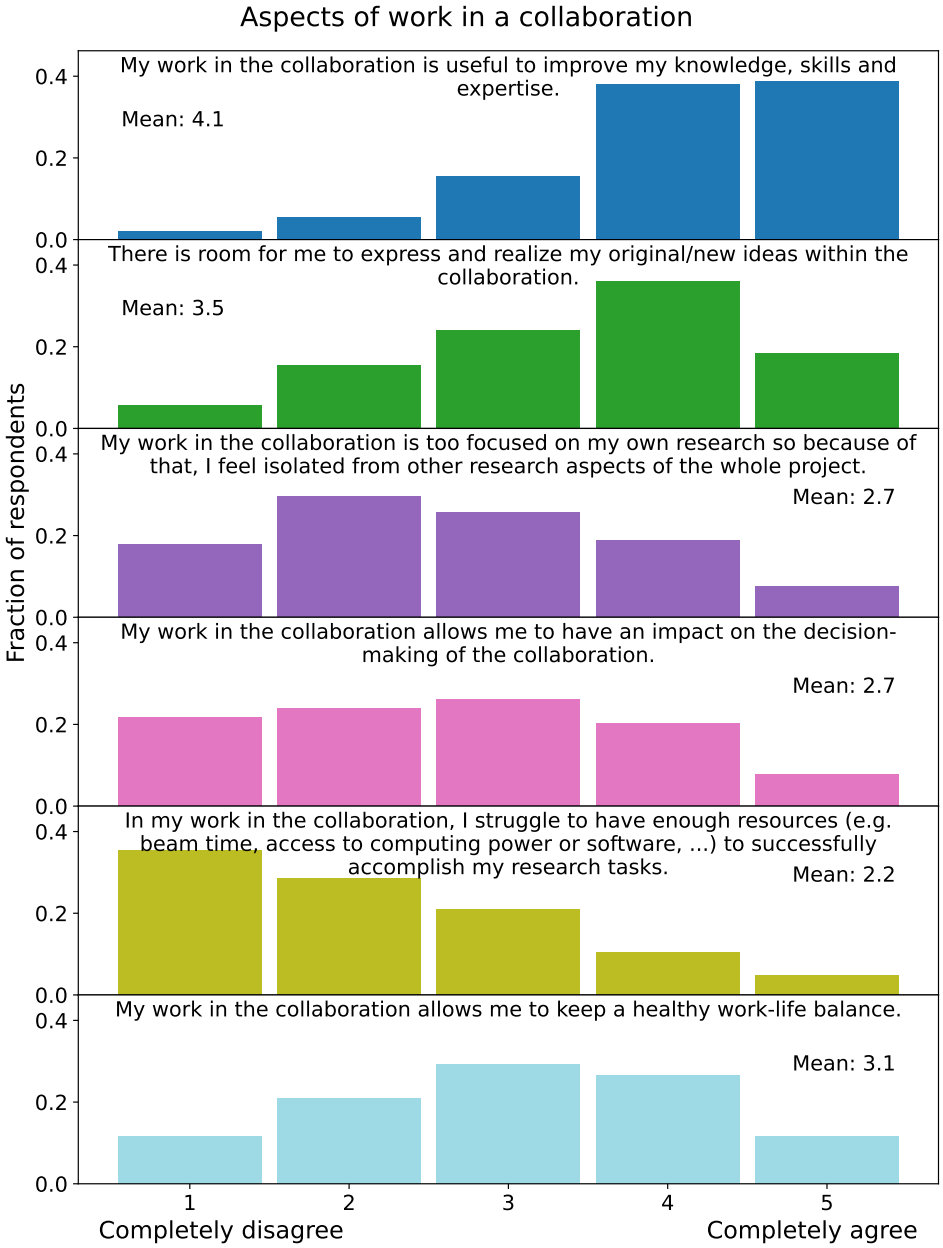

Figure 33: (Q36-41) Aspects of respondents' work in their collaboration. Fractions are given out of all respondents who are part of a collaboration.

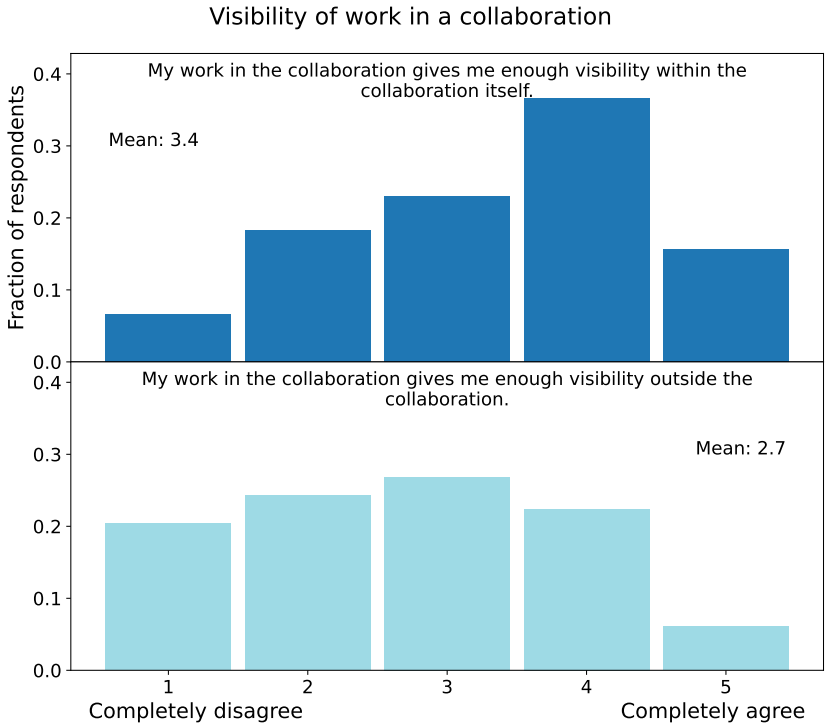

Figure 34: (Q42-43) Visibility of respondents due to work within their collaboration. Fractions are given out of all respondents who are part of a collaboration.

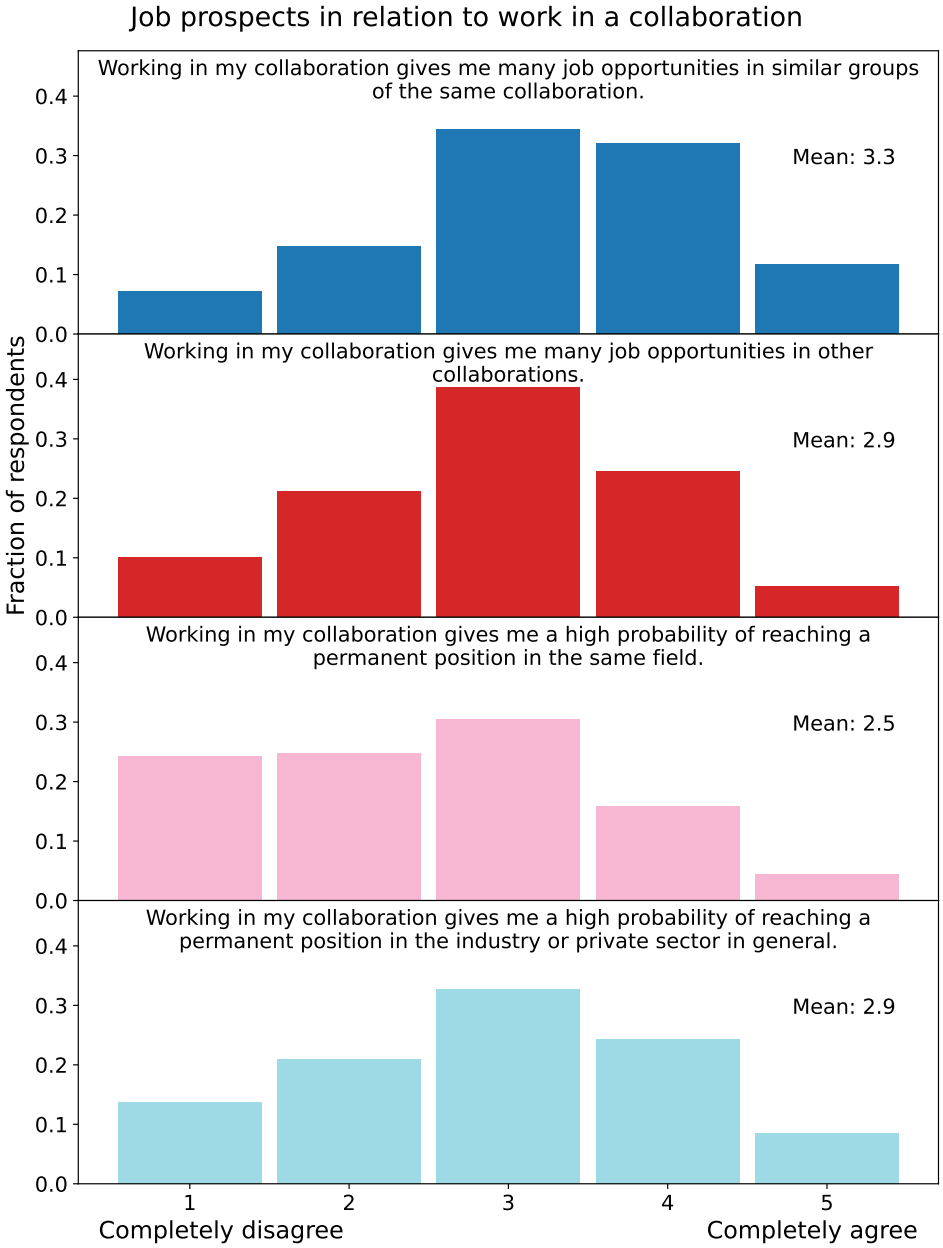

Figure 35: (Q44-47) Respondents' views on how work in their collaboration affects their job prospects. Fractions are given out of all respondents who are part of a collaboration.

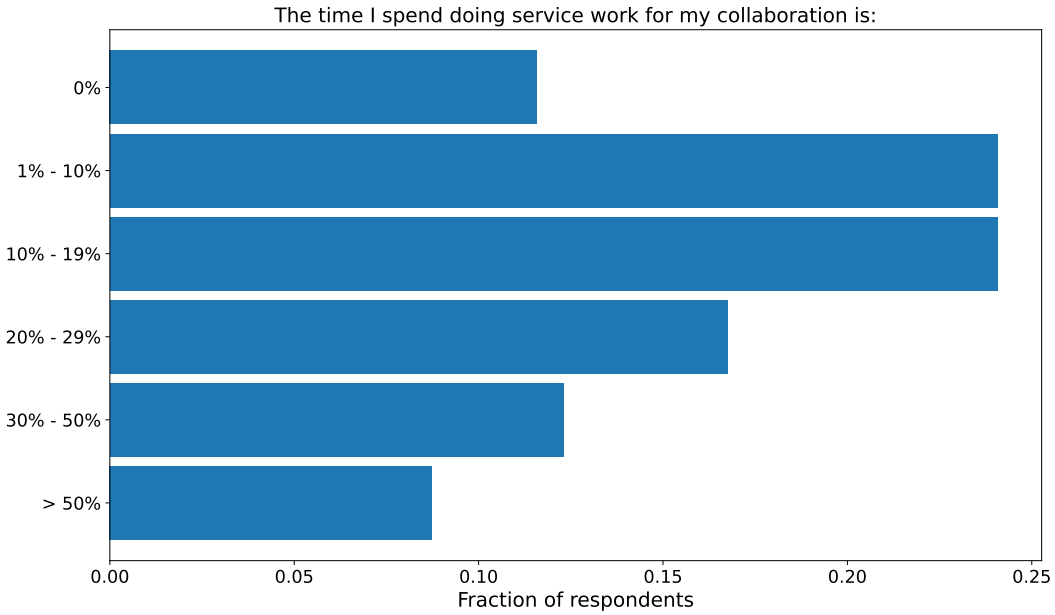

Figure 36: (Q48) The time respondents spend doing service work for their collaboration. Fractions are given out of all respondents who are part of a collaboration.

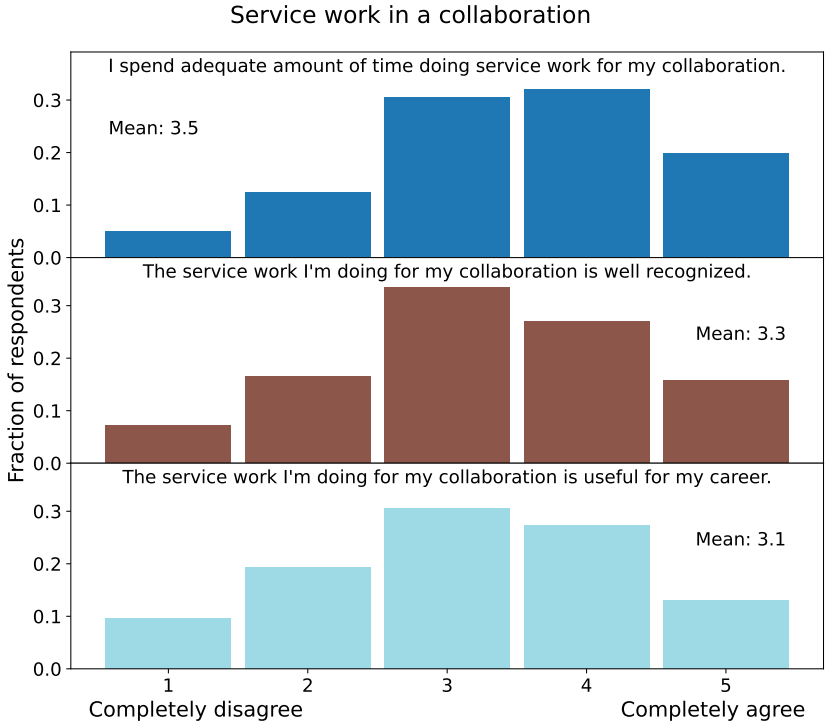

Figure 37: (Q49-51) Respondents' views on the service work done for their collaboration. Fractions are given out of all respondents who are part of a collaboration.

5 Diversity of Physics programs

In the next question, the respondents were asked to provide their level of agreement with the statement "The diversity of physics programs (e.g different experiments, large variety of physics analyses) is a fundamental requirement for a fruitful development of Particle Physics". The results are shown in Figure 38. The vast majority of the participants agree with this statement.

In the next two questions, views on working on experiments that are under construction were probed. Two questions were asked, shown in Figure 39. We can see that participants tend to think that working in the experiments under construction is harder for ECRs but offers additional career prospects.

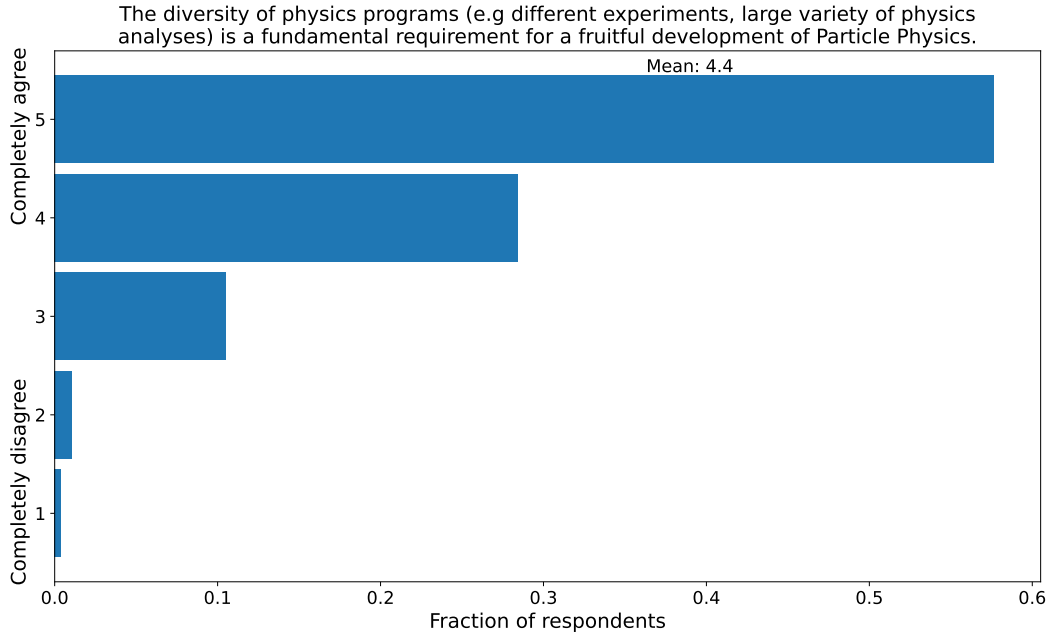

Figure 38: (Q52) The level of respondents' agreement with the statement "The diversity of physics programs (e.g different experiments, large variety of physics analyses) is a fundamental requirement for a fruitful development of Particle Physics".

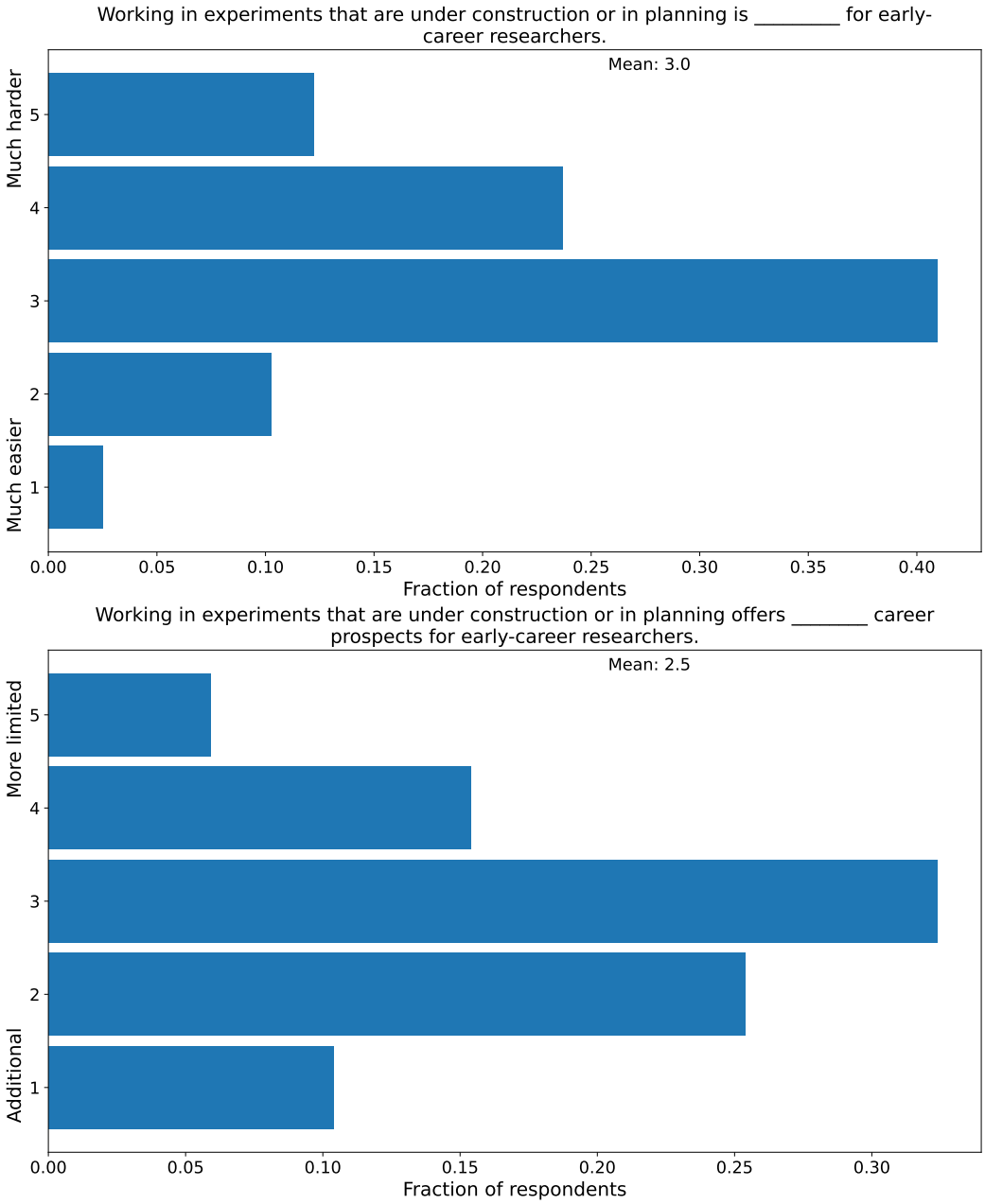

Figure 39: (Q53-54) Respondents' views on the difficulty of working in experiments that are under construction and how this work affects their career prospects.

6 Career perspective and planning

6.1 Information on career prospects

In Figure 40, respondents are asked how well-informed they are about funding and training opportunities, resources, and what is needed to advance their careers. The majority of respondents do not feel well-informed about function opportunities in their current country of employment. This majority grows when considering other countries in Europe, and is substantially bigger when considering funding opportunities outside of Europe. The majority of respondents do not agree that they are well-informed about opportunities for career training, resources on training for job applications, or where to find advice and guidance regarding career progression. On the other hand, most respondents agree that they are well-informed about what is needed to advance their careers in academia. Far fewer respondents agree

that they are well-informed on what is needed to advance their careers outside of academia.

The resources respondents use to find information on job vacancies are shown in Figure 41. Multiple answers could be entered by each respondent, and the majority of respondents use InspireHEP. Of responses entering the 'Other' category: 32% indicated email; 15% word of mouth; 4.2% from discussion with their supervisor; 18% LinkedIn; 18% other websites; 3.5% national or funding agency resources; 3.5% social media; 2.1% institute resources other than web pages; and 2.8% industry websites. Some examples of websites/companies reported by respondents include: Researchgate, Indeed, EURAXESS, Stepstone, Xing, jobs.ac.uk, academics.de, PolytechnicPositions, findaphd, CERN Alumni, AAS Job Register and EuroScienceJobs.

Figure 42 shows how prepared respondents feel for the next stage in their career. Slightly more respondents feel unprepared than prepared, but most don't have a strong view on this statement.

Focusing further on discussion of career prospects, we show how well respondents agree that they discuss their career prospects enough with various people in Figure 43. Around half of respondents discuss career prospects enough with their peers, whilst around 30% of respondents each agree or disagree that they discuss this enough with their supervisor. Less than 30% of respondents feel that they discuss their career prospects enough with other senior researchers.

6.2 Valuing research skills

Figures 44-46 address a series of questions regarding the attributes that a high-quality researcher should possess, and a successful career in academia.

Figure 44 shows the histograms with the answers to the question "What importance do you personally attribute to the following items of high-quality researcher?", for a selection of items. In Figure 45, the answers to the question "From your point of view, what importance does the scientific community attribute to the following items for a successful career in academia?" are shown for each of the same items. The histograms illustrating the answers to the question "Thinking about your academic profile, how do you feel about those points?" are shown in Figure 46, for the same set of items.

From Figures 44 to 46 one can conclude that respondents acknowledge all the attributes as important for a high-quality researcher with service work being the only attribute in the list with average personally assigned importance below 3. For almost all attributes the level of assigned importance is higher than the level of self-confidence in terms of a given attribute, here again, the service work is the only attribute in the list with the opposite result.

A particularly interesting aspect of Figure 44 - 46 is which of the high-quality researcher attributes are underrated and overrated by the scientific community through the eyes of respondents.

Respondents believe that the importance of professional mobility, publications and bibliographic metrics, conference talks, and activity in boards, panels, etc. are overrated by the scientific community. On the other hand, they find specialised expertise, expertise in a variety of domains, soft skills, and outreach underrated by the scientific community.

Respondents assign the same average level of importance to international collaborations, networking, and service work as they believe the scientific community assigns (the distributions of answers for those items are however slightly different for personal and community judgement on their importance).

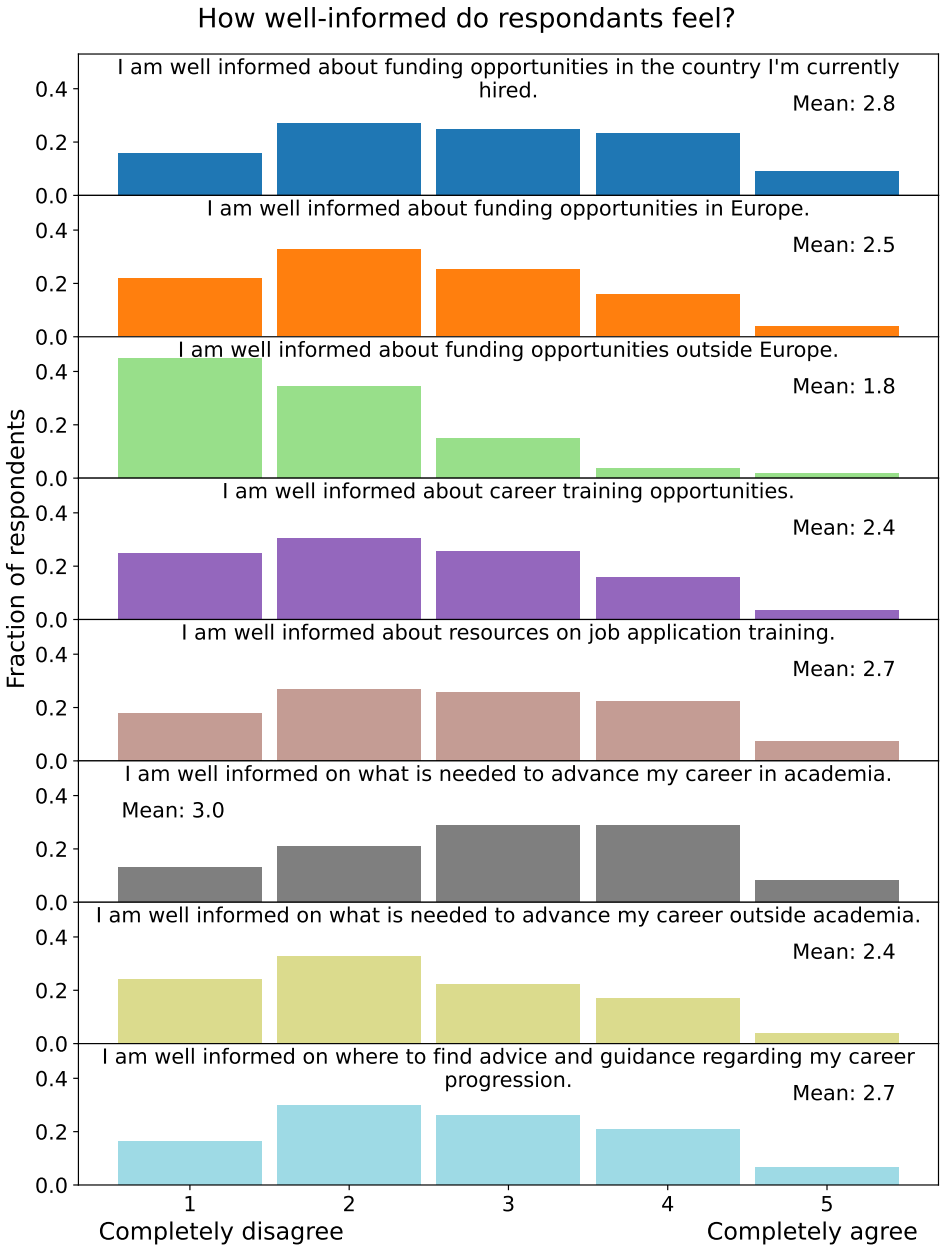

Figure 40: (Q55-62) How well-informed respondents feel about aspects of future career planning.

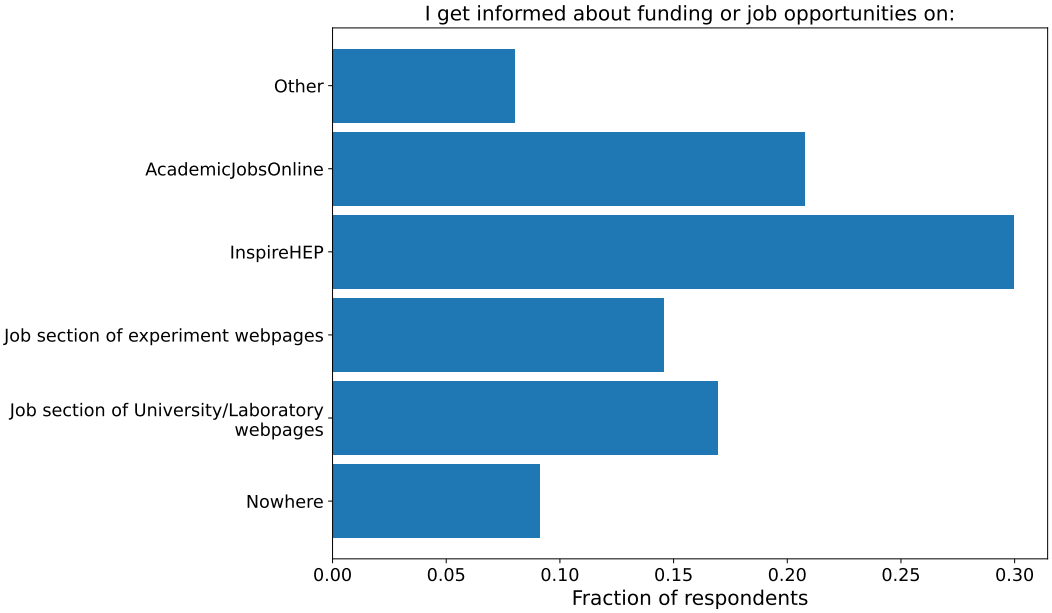

Figure 41: (Q63) Resources respondents use to learn about academic job vacancies. Multiple answers were allowed per respondent. Fractions are given out of all respondents and empty responses are not shown.

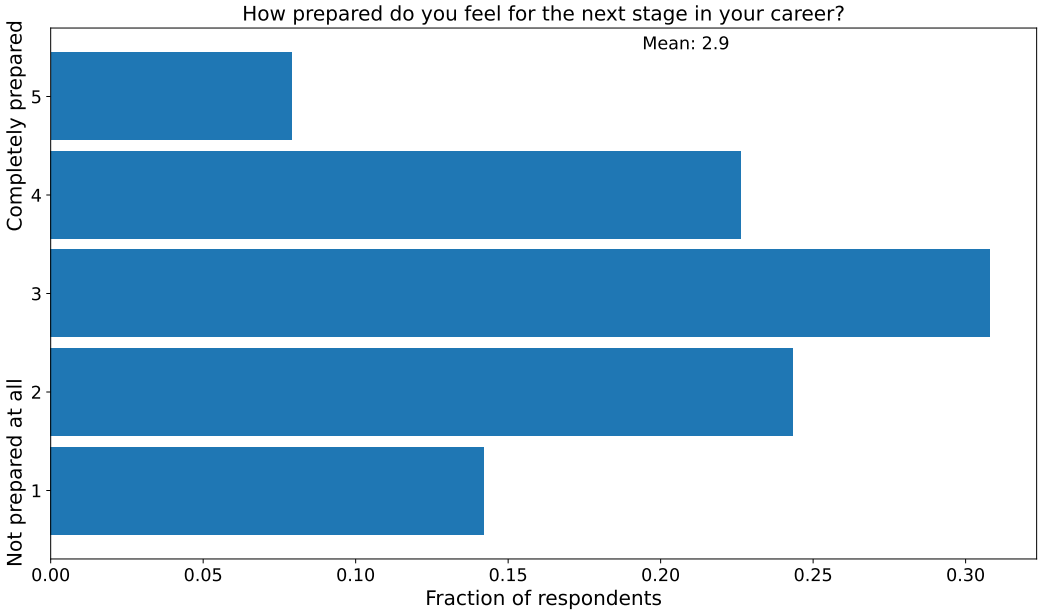

Figure 42: (Q64) How prepared respondents feel for the next stage in their career.

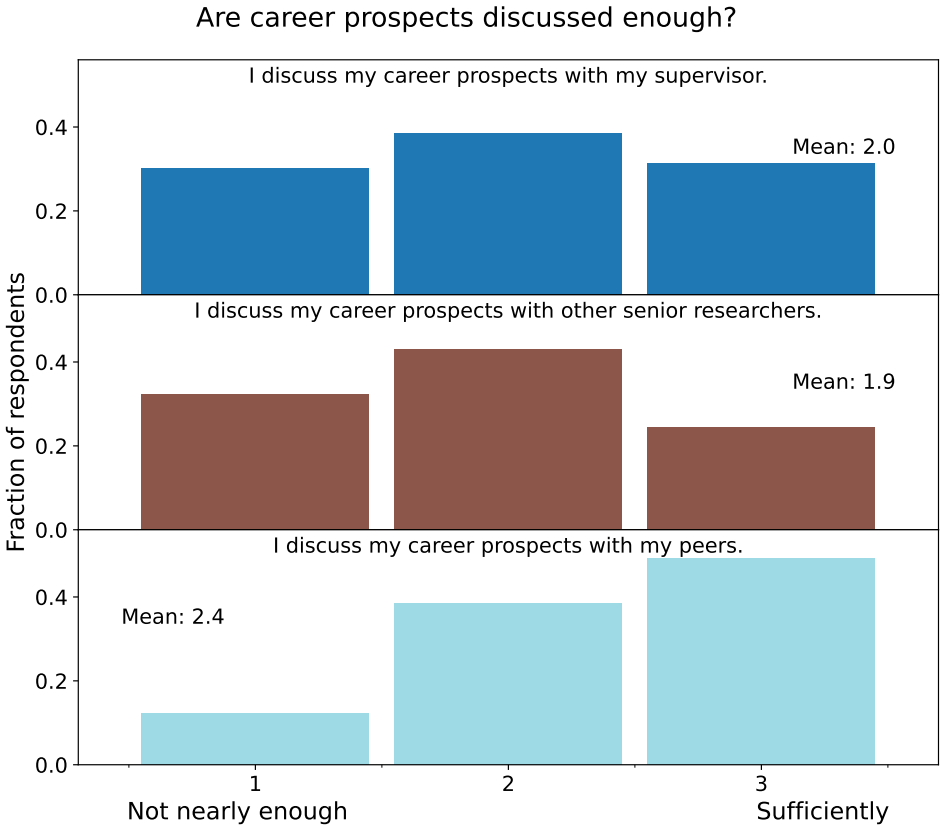

Figure 43: (Q65-67) How much respondents agree that they discuss their career prospects with various people.

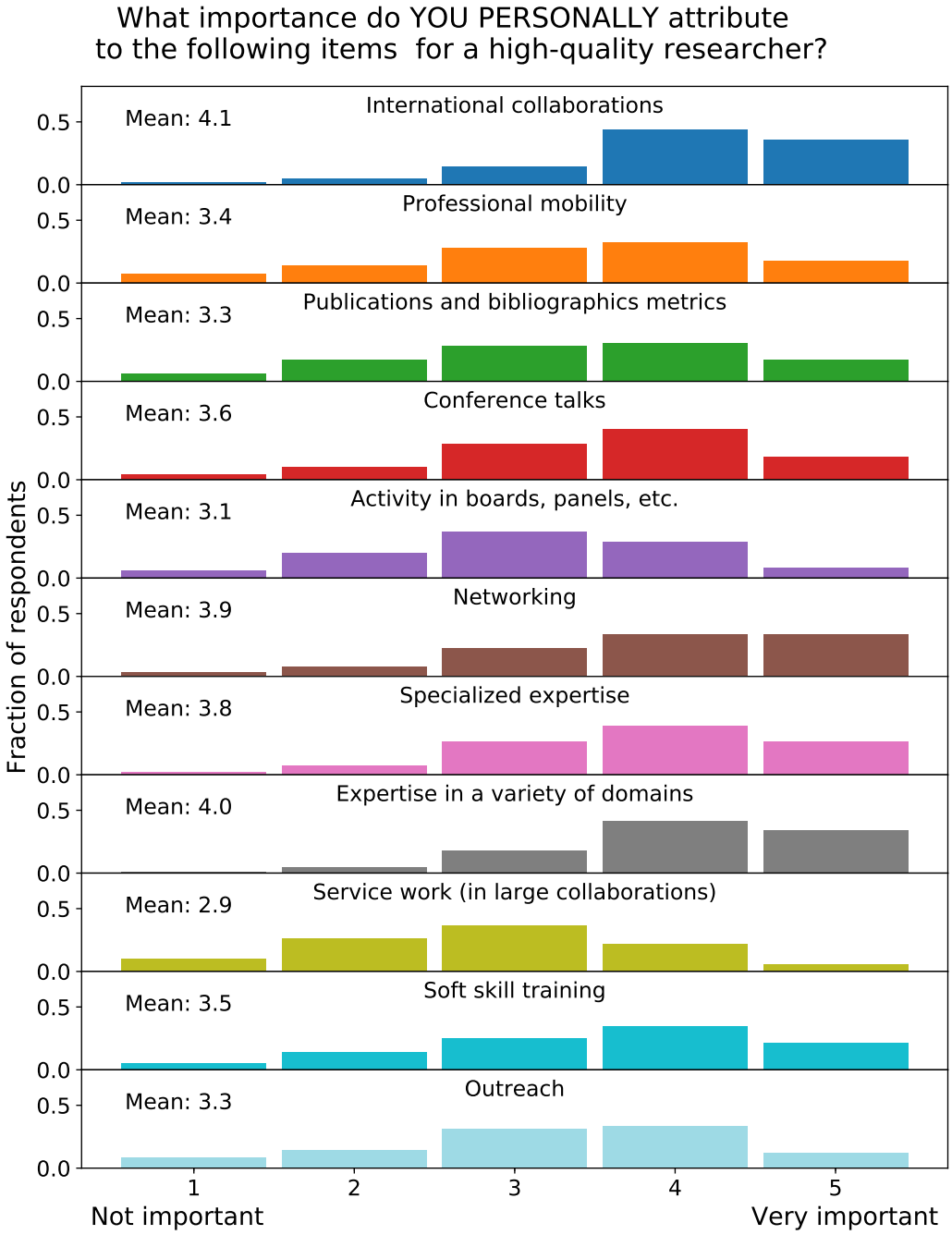

Figure 44: (Q68) Respondents' own views on the importance of various aspects of research to being a high-quality researcher and having a successful career in academia.

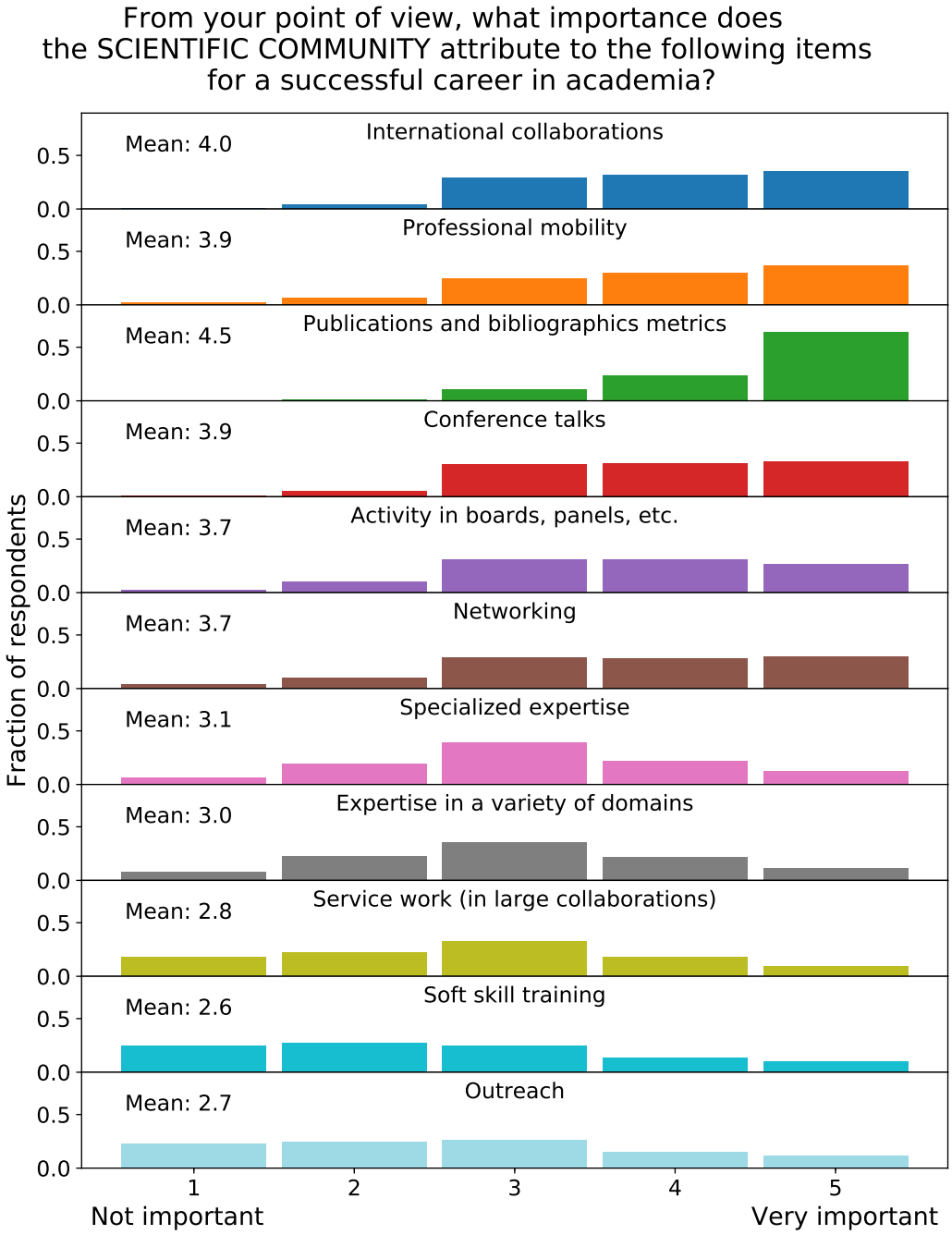

Figure 45: (Q69) Respondents' views on the importance of various aspects of research attributed to being a high-quality researcher and having successful career in academia according to the scientific community.

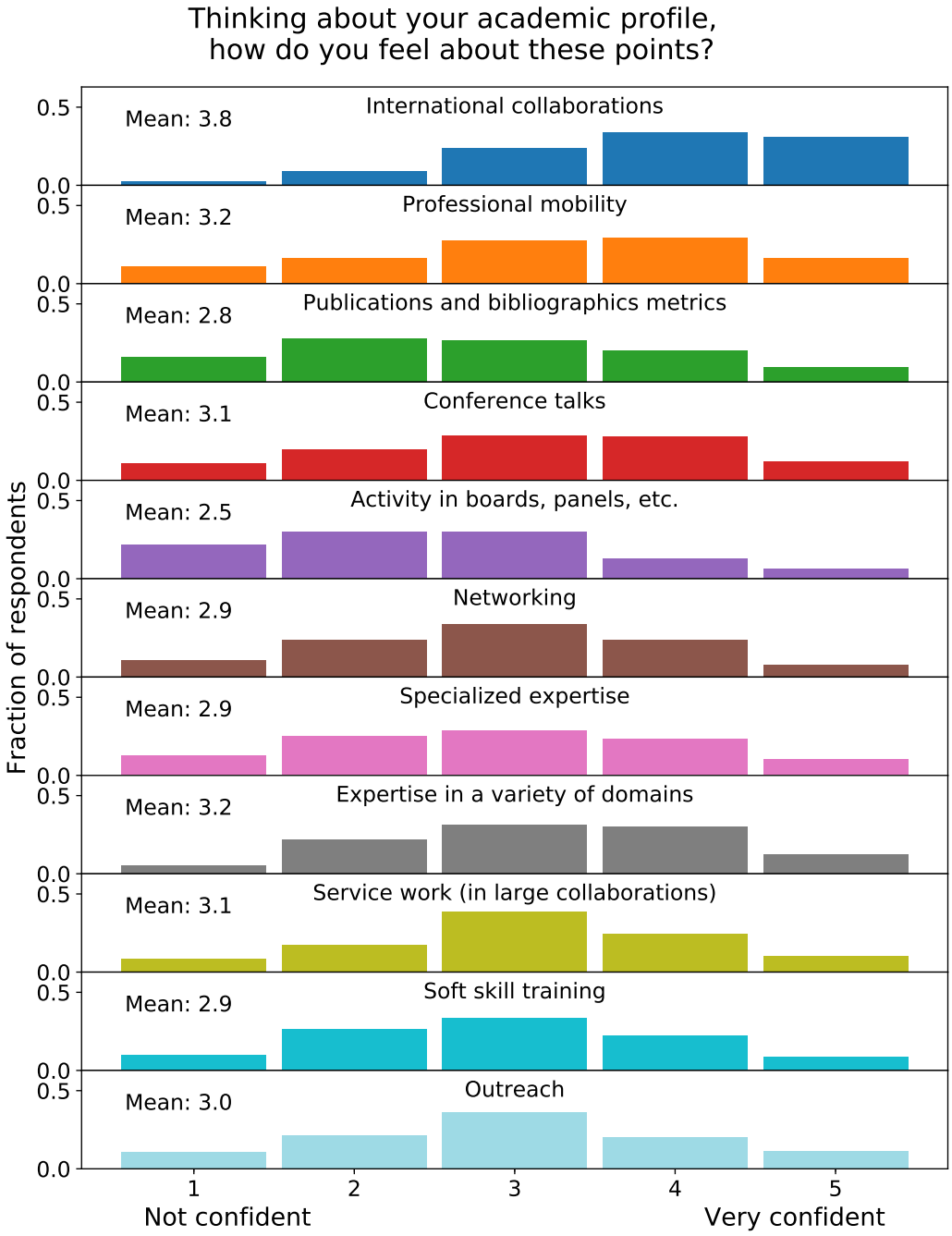

Figure 46: (Q70) Respondents' views on their fulfillment of various aspects attributed to being a high-quality researcher and having a successful career in academia.

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7 Work-life balance and career mobility

One of the goals of the survey was to investigate different aspects of the work-life balance of respondents. This is explored in this section.

7.1 Work-life balance

Figure 47 illustrates answers to the question "Do you have children?". We can see that 86% of the respondents do not have children.

Figure 48 shows at which career phase(s) respondents had a child (children). The majority of children were born during post-doc and PhD phases, but we emphasise that the majority of survey respondents are PhD students and post-doctoral researchers. The 'Other' category related to a respondent having a child during a career break between PhD and post-doc.

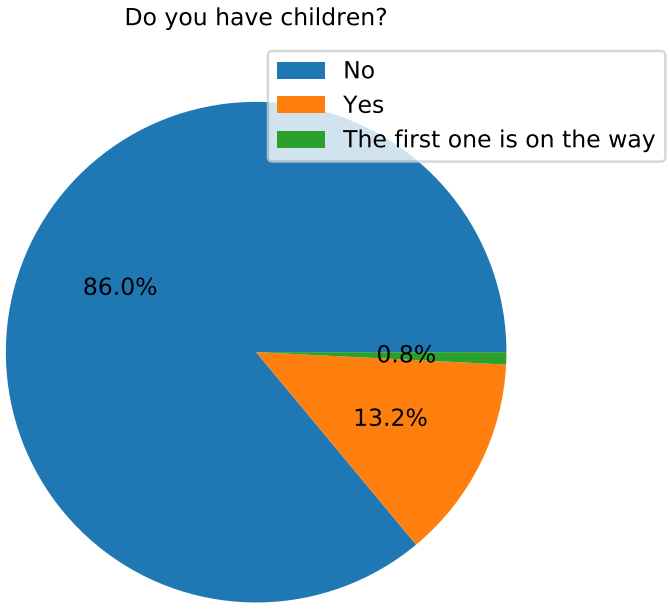

Figure 47: (Q71) Pie chart showing what fraction of respondents have children.

Figure 49 shows the respondents' answers to the question "How important are the following items to you in order to have a good work-life balance?", for several items. Figure 50 shows the answers of the respondents to the question "To which extent are these aspects fulfilled in your current job?", for each of the same set of items. Figure 51 shows the answers of the respondents to the question "In your opinion, to which extent are these aspects fulfilled in your field of research?", for the same set of items.

Figures 49 - 51 indicate that respondents find all the listed aspects to be important (the averaged assigned importance above 3 for all items from the list), with the highest importance assigned to a positive work environment and the lowest to the possibility of part-time work or job-sharing. One of the highest rated aspects are the flexible working hours. We can also see that this is the aspect to which the average level of fulfilment in the current jobs of respondents is the highest. Also, the positive work environment and flexible working location are fulfilled in most of the current jobs of the respondents and very important for them to have a good work-life balance. The biggest discrepancy between what respondents find important for a proper work-life balance and the fulfilment in reality is the possibility of long-term planning. The average level of fulfilment in the current jobs of respondents is only 2.2. For all aspects, respondents perceive that aspects of a good work-life balance are fulfilled more successfully in their current job than in general in their research field.

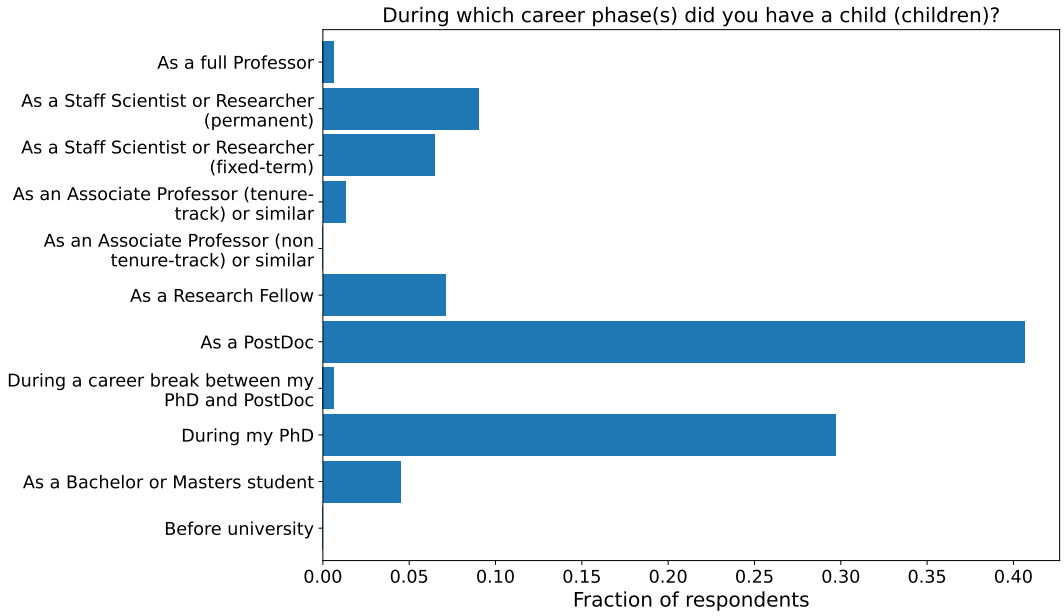

Figure 48: (Q72) The career phases during which respondents had children. Multiple answers per respondent were allowed, and responses are shown as a fraction of all respondents who have had children.

the level of fulfilment in the respondents' current job is higher than respondents perceive fulfilment levels in research to be in general. However, the differences are rather small.

Next, the respondents' opinions on the impact (or potential impact) of various aspects of work-life balance on their research was studied. The answers are summarised in Figure 52. According to the respondents, flexible working hours are expected to have a strong positive impact on research, whilst having to relocate is viewed very negatively in this context.

Figure 53 demonstrates that most respondents to the survey feel stressed and work overtime very frequently. 21% of respondents work overtime almost daily. 50% of respondents feel stressed and under a lot of pressure at least once a week.

7.2 Career mobility and leaving academia

In the survey, respondents' experiences connected with career mobility were studied. Figure 54 shows respondents' family situation if they moved in order to undertake a new position in HEP. Multiple answers could be selected per-respondent. The majority of the respondents moved alone since they were single at that time. However, almost as many respondents moved alone despite being in a relationship and/or having children.

Responses to the question "Which problems or difficulties did you or your family members encounter when moving abroad for your new position?" are presented in Figure 55. Multiple answers were allowed per respondent. The most common problems concern: difficulties with language; finding new friends and developing a social life; difficulties in finding housing; and missing home, the family, or the country. The least popular problem is difficulties in finding childcare/schools, which is not unexpected as only approximately 13% of respondents have children.

The mobility questions triggered many additional comments in the survey. This illustrates the importance of this aspect to the respondents and its emotional impact. Some of the most common or serious comments shared by the respondents in the open 'Other' box are quoted in Appendix C.

We summarise the views of respondents currently living abroad (over 52% of the total) on whether they would like to move back to their home country in the future in Figure 56. Overall, most respondents who are living abroad would like to go home eventually. Out of respondents in the 'Other' category: 48% were unsure and said it would depend on the circumstances (such as their partner's location and the quality of life); 31% didn't mind; and 21% said they would like to stay abroad but cannot, for example due to a lack of job opportunities or the socio-political climate.

Figure 57 shows what factors respondents used when choosing their current position (with multiple answers allowed per respondent). By far the strongest factor is being interested in the work of the

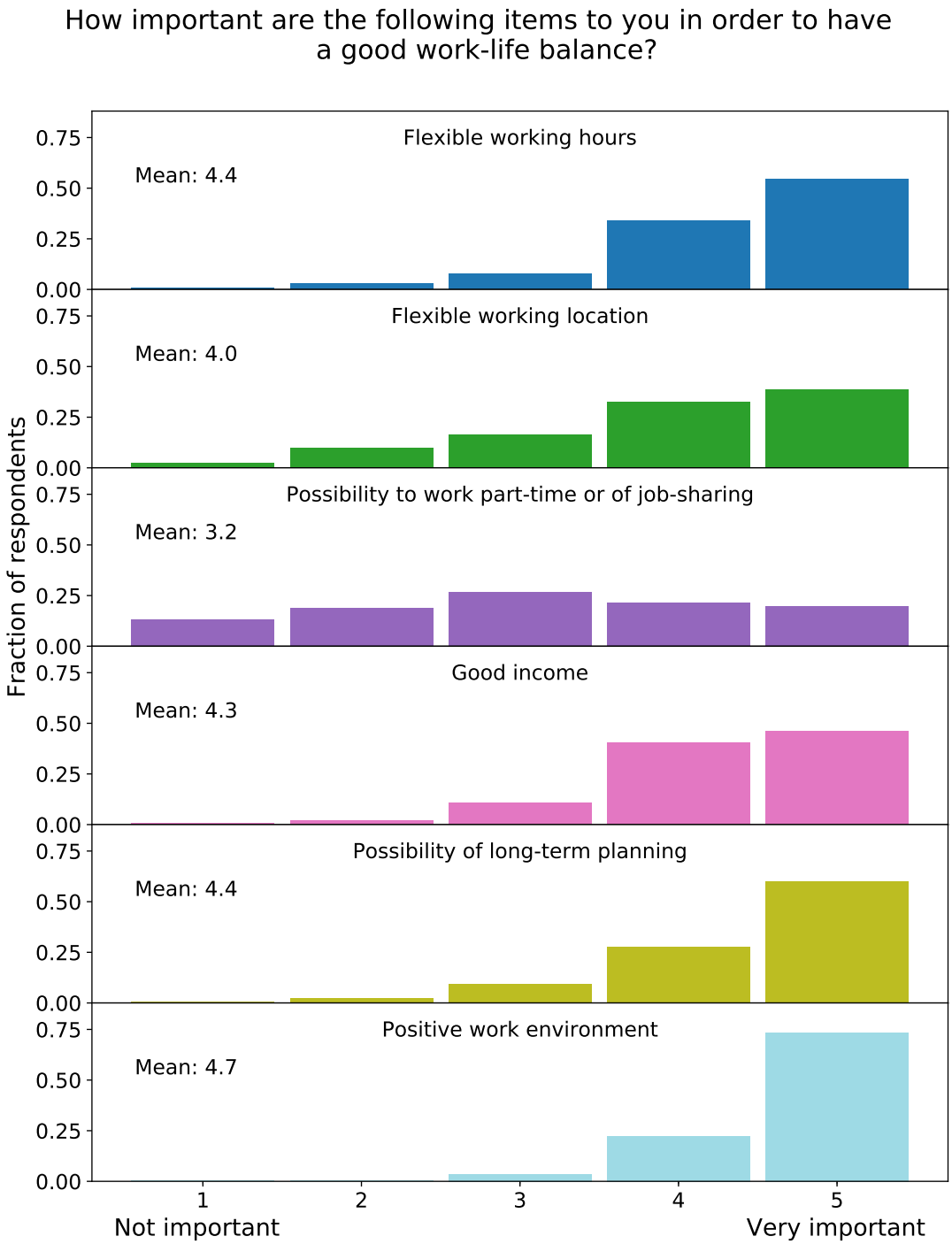

Figure 49: (Q73) Respondents' views on the importance of different aspects of a good work-life balance.

group/PI, followed by already collaborating with the group/PI, having good terms in the offer, and not wanting to change field. Sightly more respondents prioritised applying everywhere possible to stay in academia compared to applying for positions with the aim of moving to a specific location. 73% of the responses in the 'Other' category related to wanting to work in the group because of its good reputation in research, work environment, etc., and 27% to getting tenure or an increased chance of tenure.

Answers to whether respondents have had a career break of longer than 3 months, and if so why, are shown in Figure 58. Only 18% of respondents have, most while looking for a new job. Within the 'Other' category: 63% took a break due to illness and 38% due to the Coronavirus pandemic. Following this, we asked respondents whether they have ever changed field within physics. 30% of respondents answered

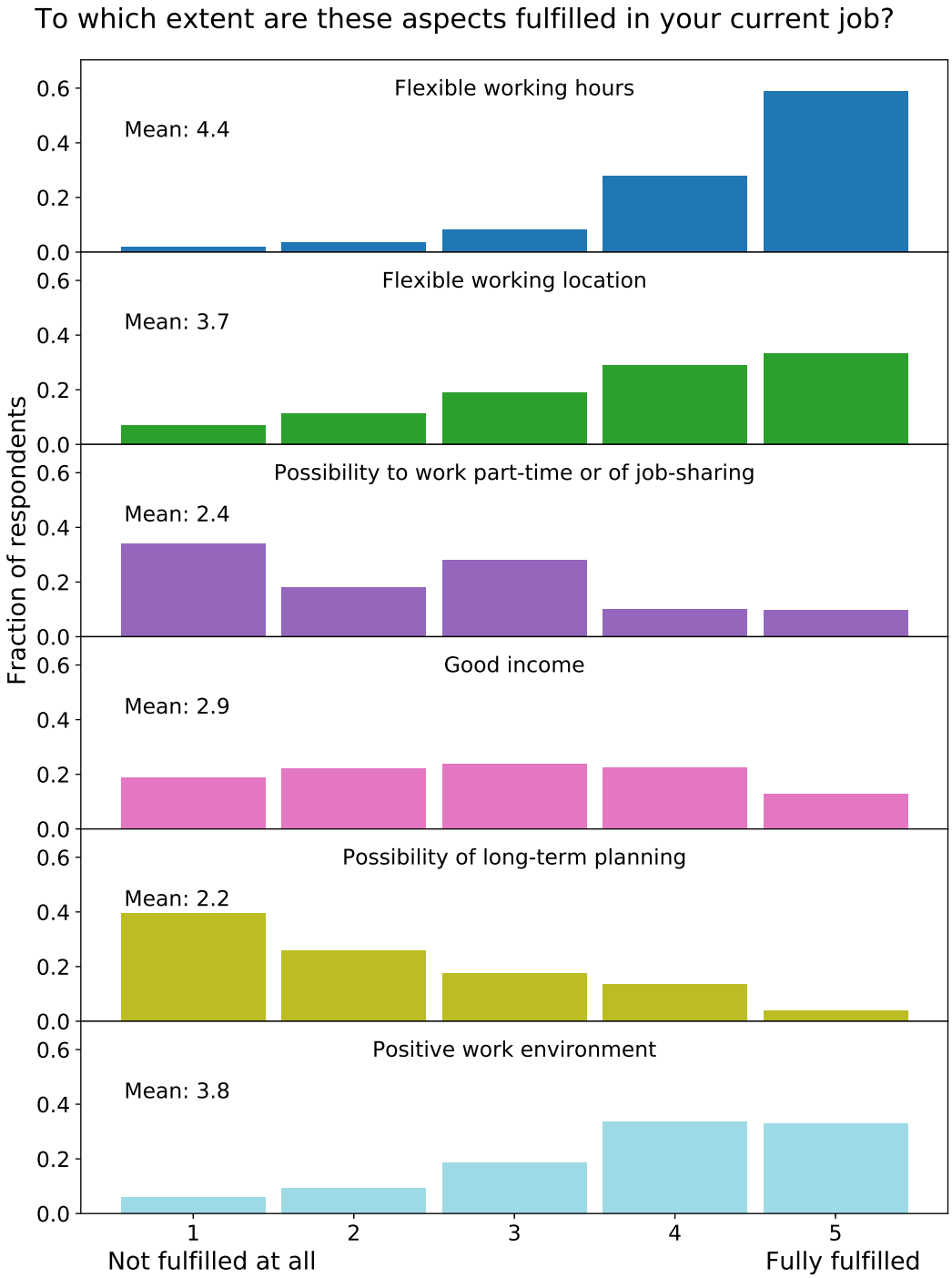

Figure 50: (Q74) Respondent's views on how different aspects of a good work-life balance are fulfilled in their current job.

yes.

Responses to the question "Are you considering leaving research in HEP after the current position?" are shown in Figure 59. Whilst 57% of respondents explicitly want to stay in HEP, only 12% think that their chances are pretty good. In contrast 10% of respondents want to leave.

Answers to the question "Which factors induced you to consider leaving research?" are summarised in Figure 60, with multiple answers allowed per respondent. We see that the three most common factors inducing respondents to consider leaving research are work-life balance, money and missing the possibility of long-term planning. The least common option, from those presented, was "moving back to

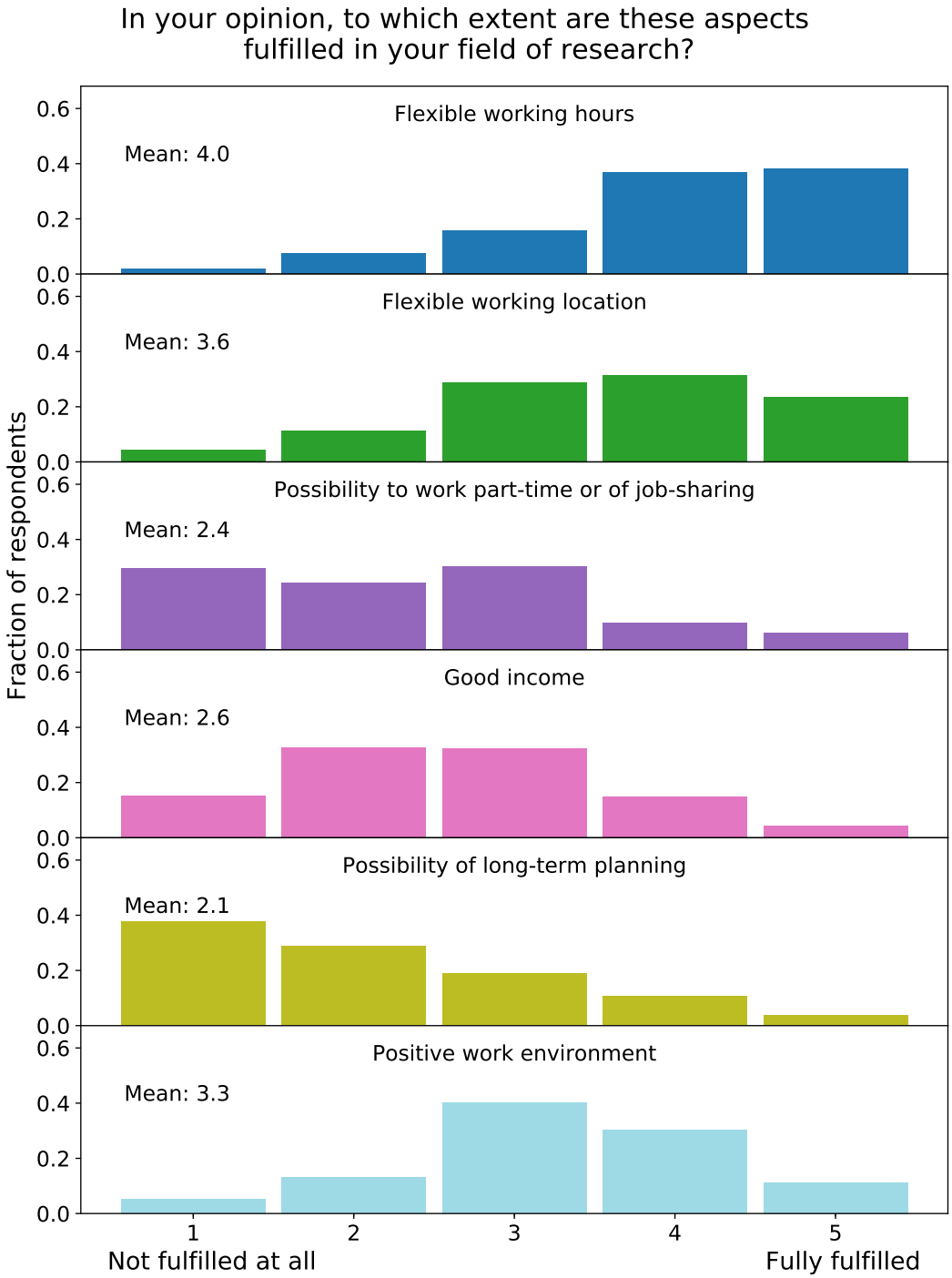

Figure 51: (Q75) Respondent's views on how different aspects of a good work-life balance are fulfilled in their field of research.

my home country". Within the 'Other' category, 32% cited systemic problems in academia, 16% lack of job opportunities, 21% social/economic/political factors, and the remainder other issues. Some of the most striking or common responses given in the open "Other' box are quoted in Appendix C.

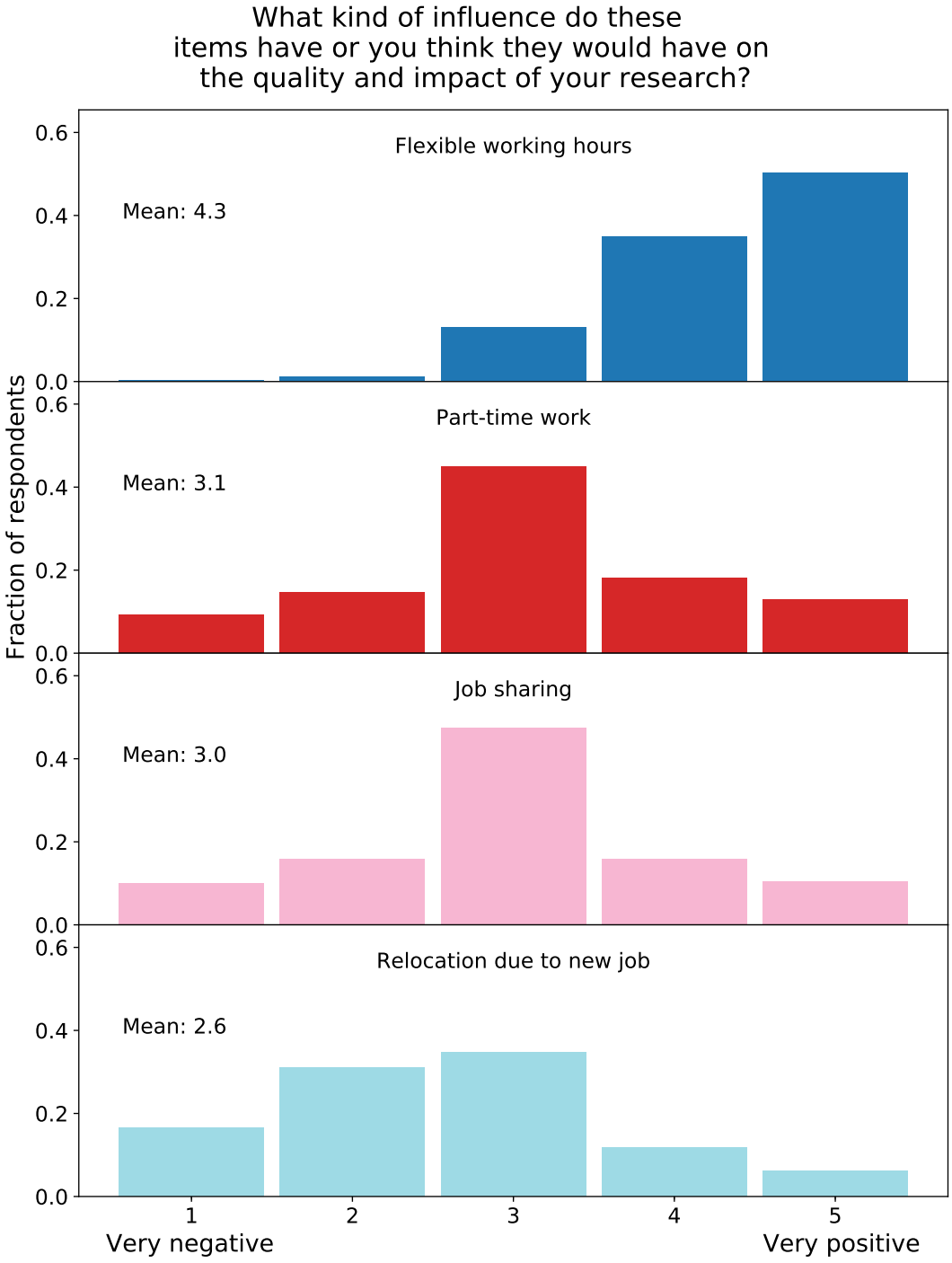

Figure 52: (Q76) Respondents' views on how positive or negative the impact on their research is for different aspects of a good work-life balance.

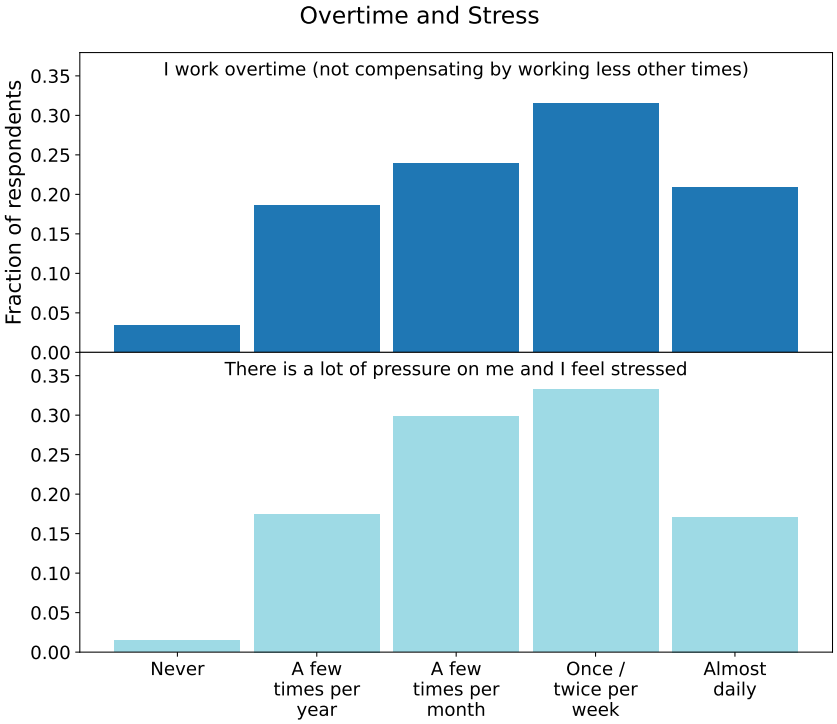

Figure 53: (Q79-80) How often respondents work overtime, or feel stressed and under pressure.

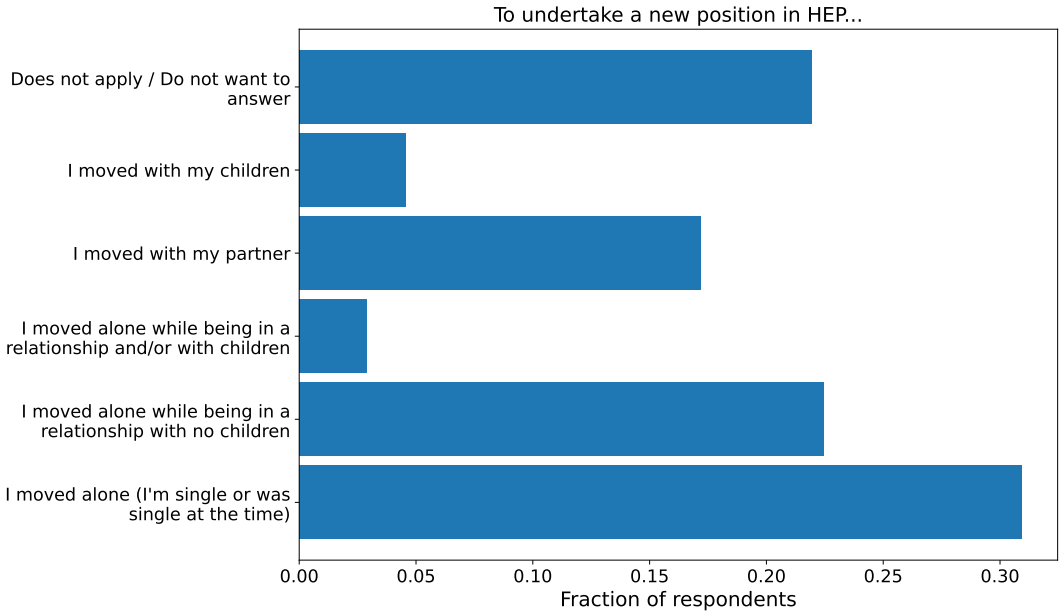

Figure 54: (Q77) Respondents' family situation while moving to undertake a new position in HEP. Multiple answers could be selected per respondent.

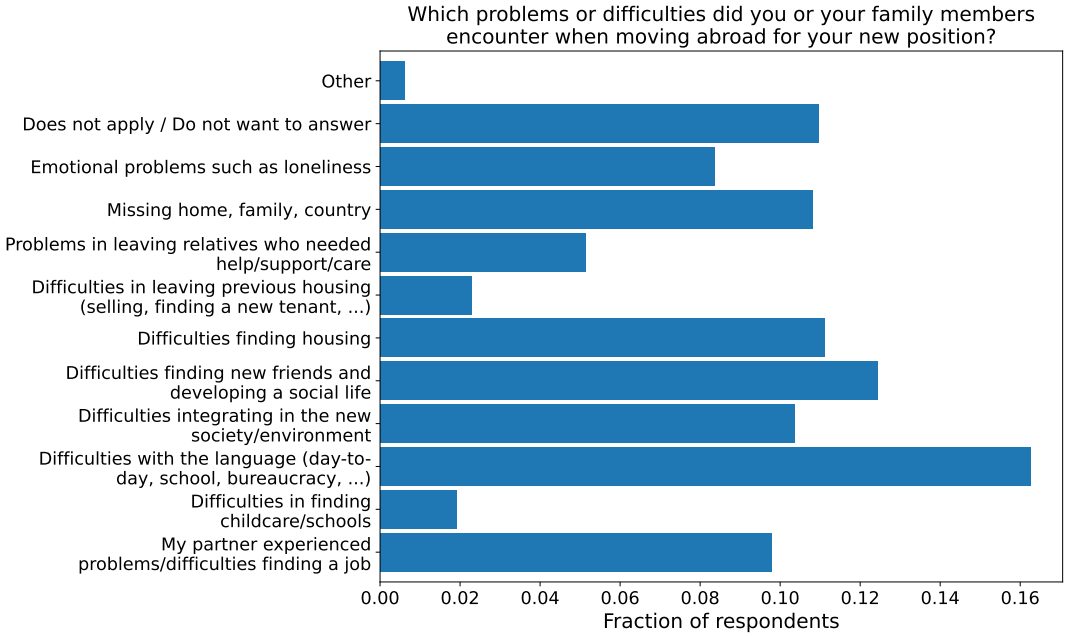

Figure 55: (Q78) The problems experienced by respondents and their family members while moving to undertake a new position in HEP. Fractions are shown out of all respondents. Multiple answers could be selected by each respondent.

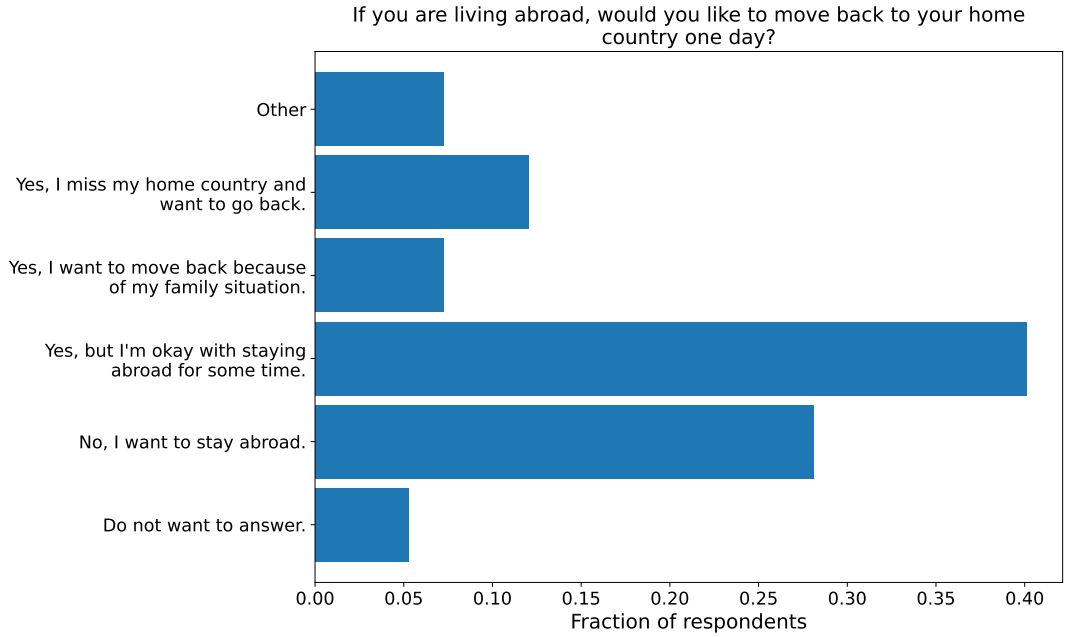

Figure 56: (Q81) The opinions of respondents who are living abroad, on whether they would like to move back to their home country. Fractions are given out of all respondents who are currently living abroad.

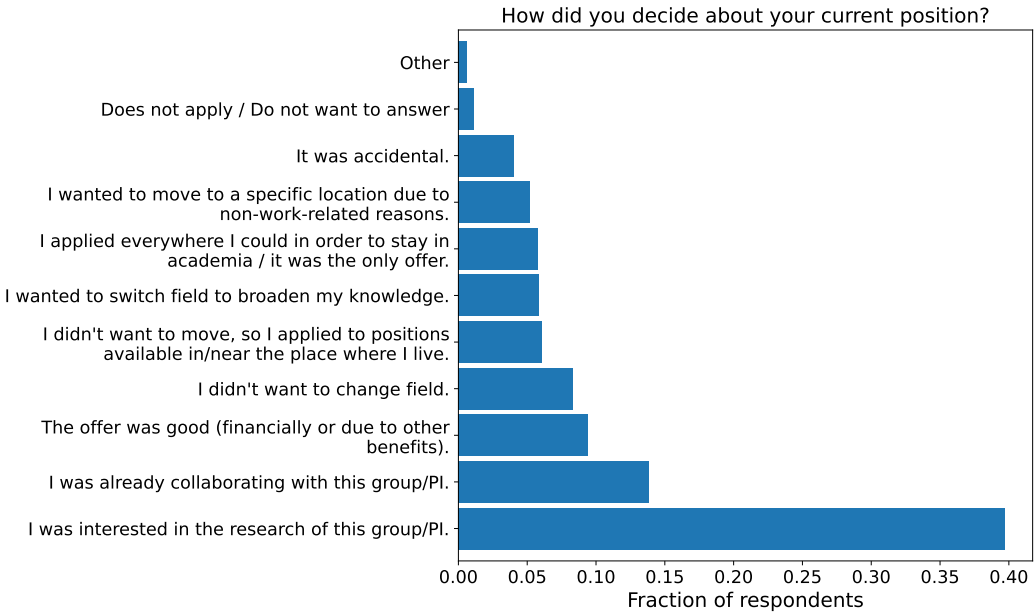

Figure 57: (Q82) The importance of various factors, to respondents, in choosing their current position. Fractions are shown out of all respondents. Multiple answers could be selected per respondent.

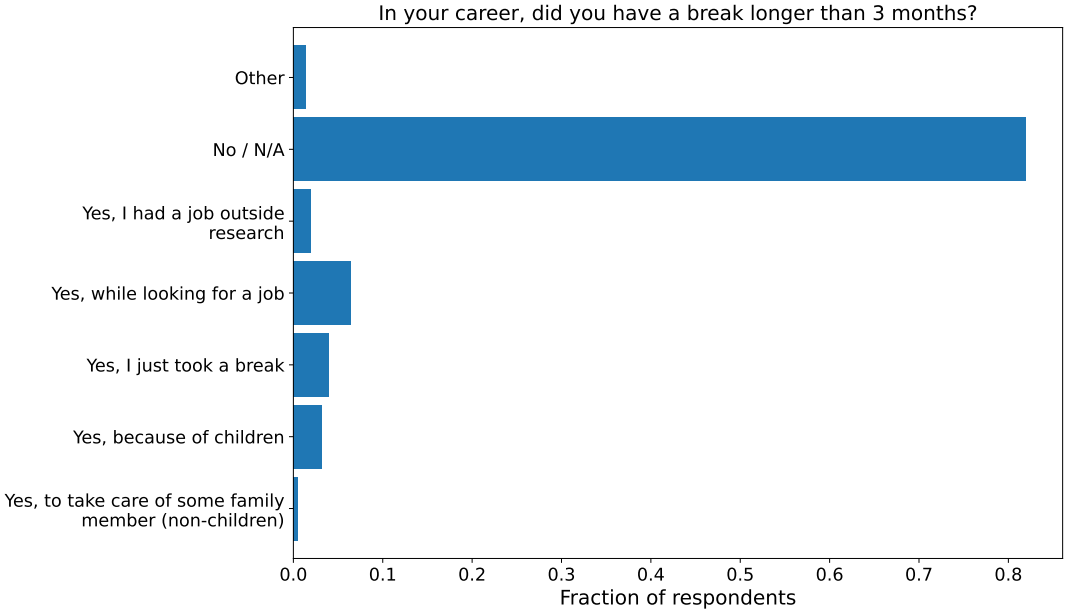

Figure 58: (Q83) Histogram showing Whether respondents have had a career break of more than three months or not, and — if so — why.

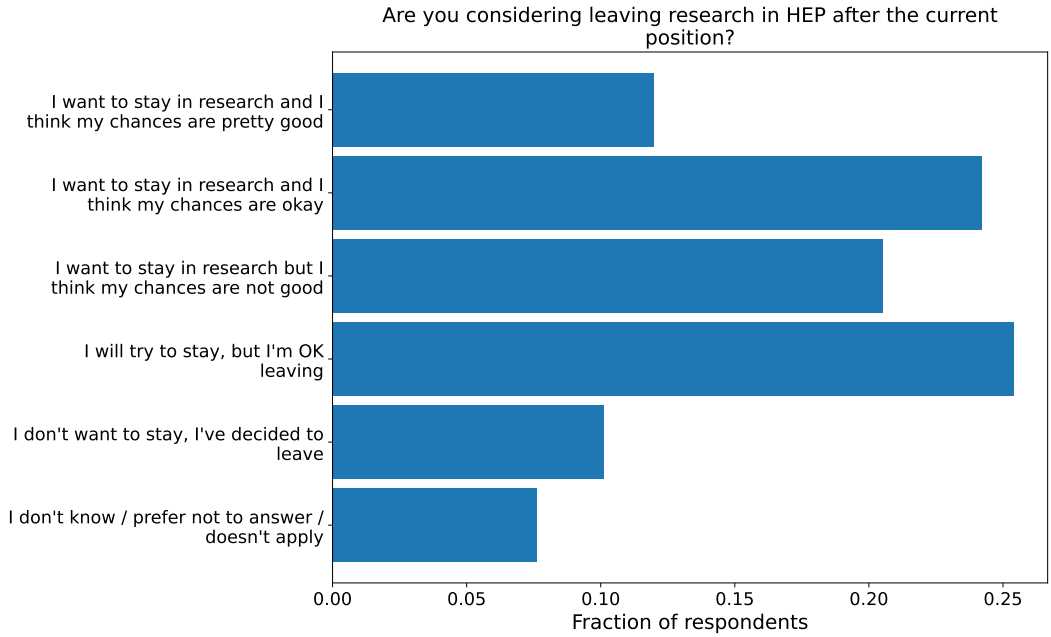

Figure 59: (Q85) Histogram showing whether respondents are considering leaving research in HEP after their current position or not.

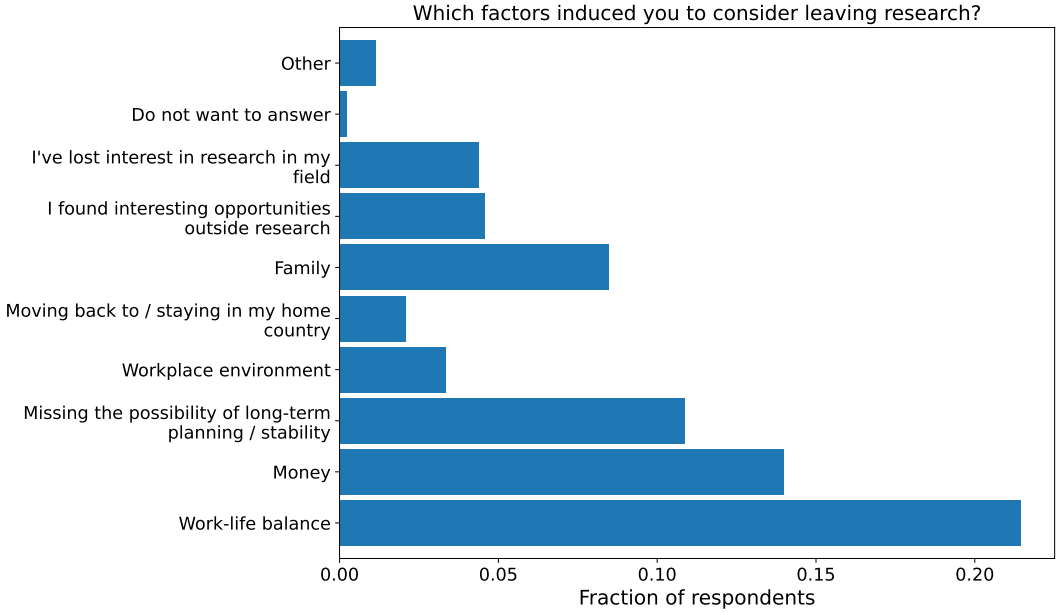

Figure 60: (Q86) Factors that induced people to consider leaving research. Fractions are given from all respondents, and empty answers are not shown. Multiple answers were allowed per-respondent.

8 Discriminatory or abusive treatment

In Figure 61, we address the serious question of whether respondents have experienced discriminatory or abusive treatment in their collaboration/group. Whilst 74% of respondents have never experienced this treatment, a non-negligible 21% of respondents have. Half of the respondents who have experienced this treatment either felt unable to seek help or asked for help but found it unhelpful. Two respondents pointed out a general culture of sexism in their collaboration/group.

After this, respondents were given a open box to answer the question "Are there any measures that would improve your personal situation?". Answers were provided by 19% of respondents, and where multiple distinct points were made, all were considered separately, though a lot of the topics are connected. Responses were grouped into categories for plotting purposes. As Figure 62 shows, responses overwhelmingly relate to the academic job market. Respondents want more job opportunities in general, and jobs with a longer or permanent contract in particular. Several respondents stressed the problems with family and long term social connections that come with having to frequently move, which were noted in previous questions also. One respondent pointed out that shorter contracts make it harder to make time for 'high-risk' research, and relating to this, three focused on the amount of time sunk into writing job/grant applications as part of the administrative overhead category. The joint second most frequently mentioned categories related to better pay and better workplace culture/environment. Examples of improvements to workplace culture/environment include: more open communication and knowledge transfer with all levels of seniority; more academic support and respect; better organisation and administrative support. Related to this, several respondents called for more education and protection against harassment/bullying and discrimination. Specific examples here include training to prevent gender bias and improved Ombudsman services. Several respondents also desired better/more-equal childcare support, or better flexibility for remote work (largely for family reasons). Similar numbers of respondents discussed two related categories: better training in soft-skills and more career mentor-ship; and for their supervisors to have more guidelines and accountability in order to fulfil their roles well.

As reflects the data in Figure 53, several respondents wished for a lighter workload: by having fewer tasks to deal with at once, by having more employment protection against unpaid overtime, or by creating a culture where over-work is not encouraged. Additionally, a few respondents wished for lower stress and pressure, or better support with their mental health and self-confidence.

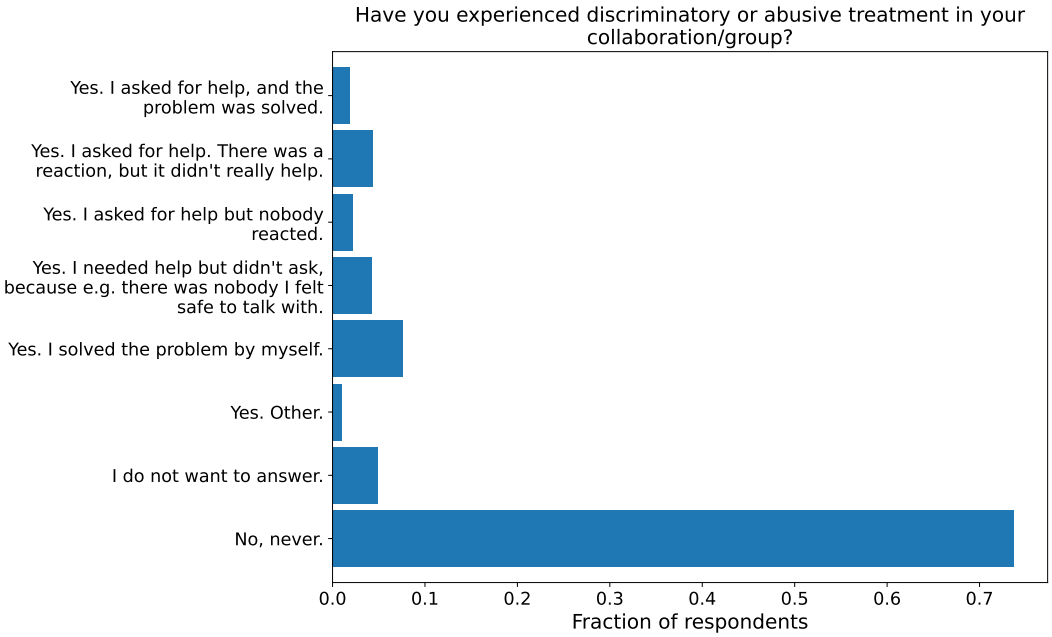

Figure 61: (Q87) Histogram showing Whether respondents have experienced discriminatory or abusive treatment in their collaboration/group or not.

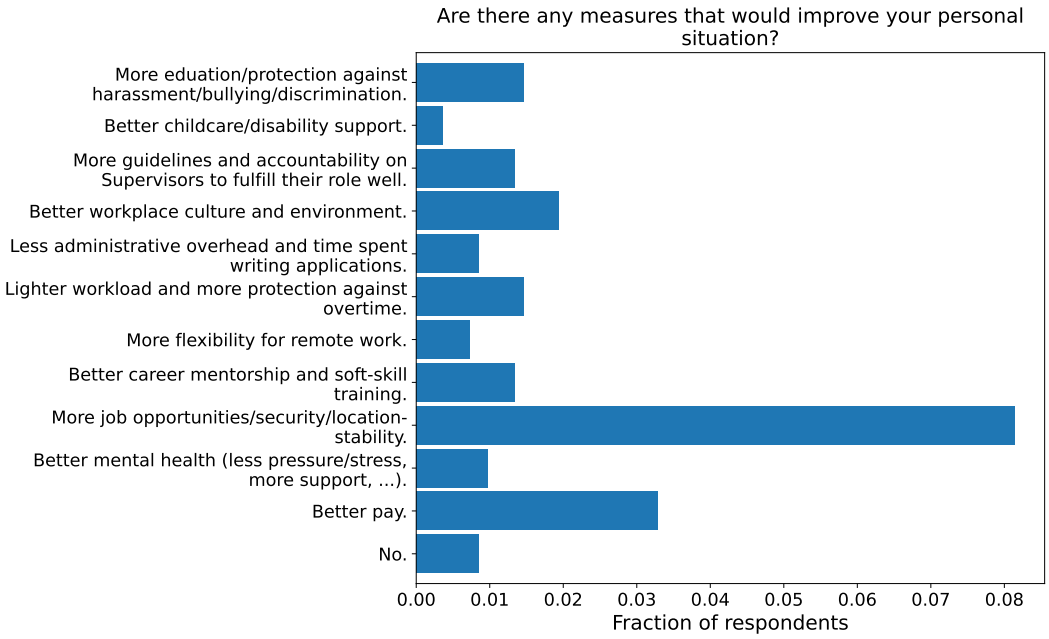

Figure 62: (Q88) The categories of measures that respondents said would improve their personal situation. The fraction given is out of all respondents, empty responses are not shown.

9 Recognition and visibility

In Figure 63, we asked respondents for their level of agreement with statements regarding the recognition and visibility they receive. In the top two panels it is shown that a clear majority of respondents perceive their group/collaboration's policies on publications and conferences to be fair. Respondents also agree, though less strongly, that the assignment of positions within their group/collaboration is also fair. The respondents' opinion on commonly used bibliometric indices (such as the h-index) is more bimodal, with most either strongly disagreeing or feeling unsure that these fairly reflect work done. Respondents also don't have a strong overall opinion about whether the way prizes are awarded in their community is fair. Finally, respondents generally agree (though not strongly) that recognition and visibility of their work at the research group/collaboration level is fair, but are less sure of this at the level of their research field.

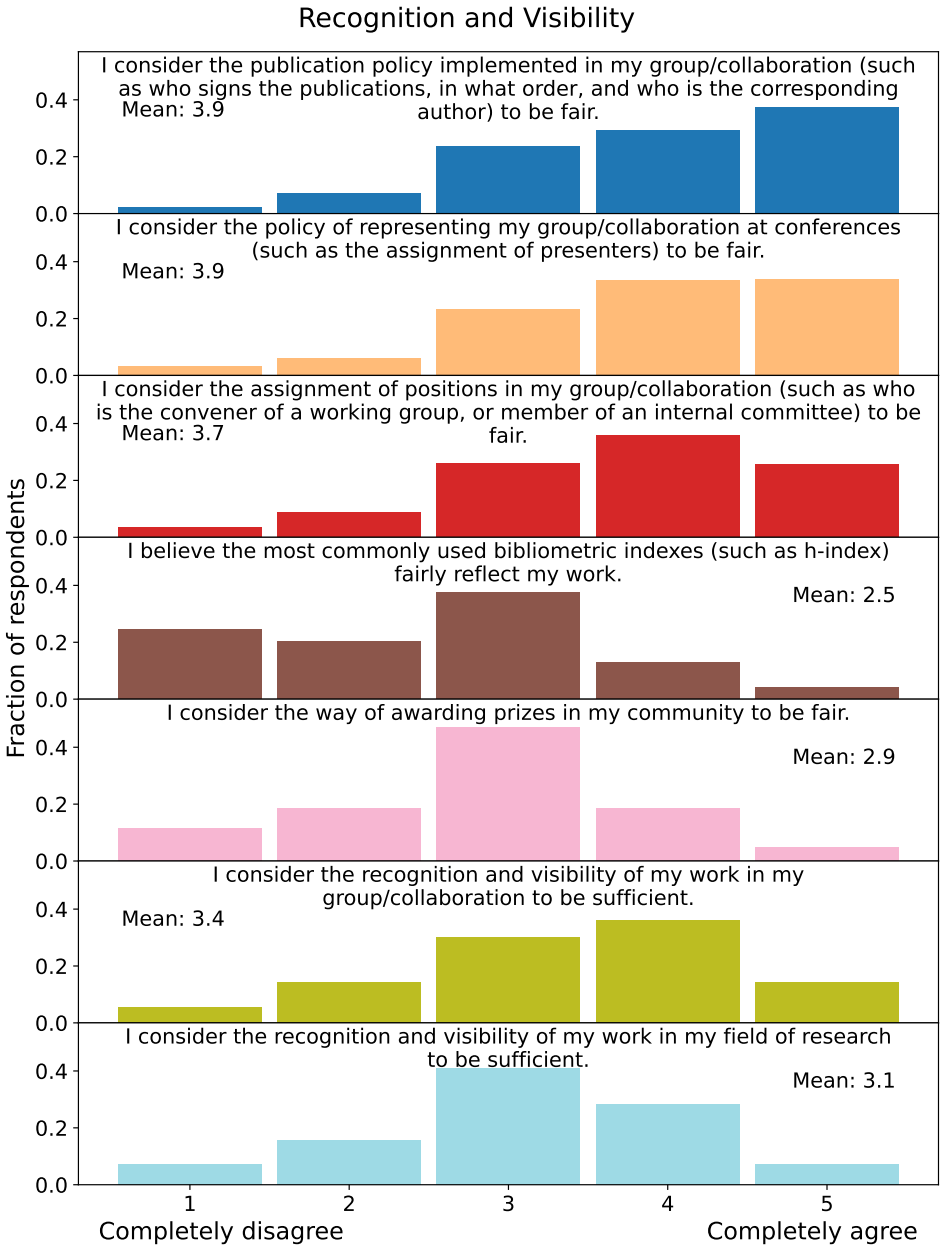

Figure 63: (Q89-95) Respondents' feelings about recognition and visibility of their work.

10 Final questions, feedback and remarks

In the last part of the survey, 3 open questions were asked. The first open question asked was "In your opinion, is there any event the ECFA Early-Career Researchers Panel could organise to help you develop your career?". We collected more than 130 responses. In addition to many proposals for events or resources which can help respondents to develop their careers and awareness of opportunities, there were some proposed actions which could help to solve issues which ECRs believe particle physics is facing. The third open question asked for feedback on the survey. We aim to use the responses to these two questions to help produce a set of recommendations for the Panel and the Particle Physics community, which will form the conclusion of the final document and the future plans of the Working Group.

The second open-form question asked for respondents' more pressing questions about their careers. The responses, allowing for multiple per persons, were grouped into categories and are presented in Figure 64. Consistent to what was seen in Figure 62, the most pressing questions related to getting a permanent job in academia, and the lack of long-term planning and stability.

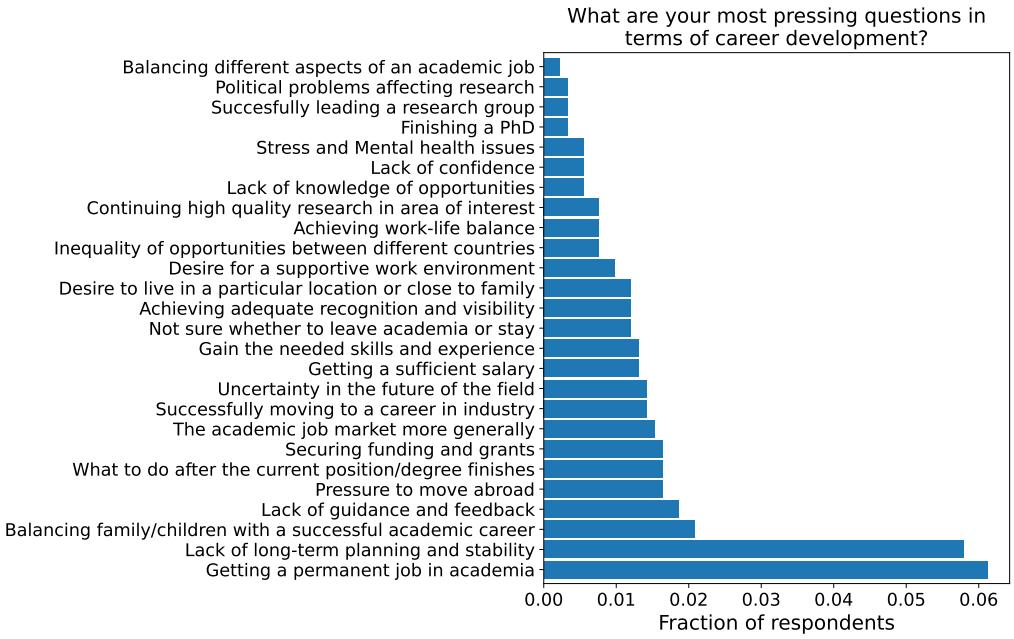

Figure 64: (Q97) The categories of pressing questions respondents have about their careers. The fraction given is out of all respondents, empty responses are not shown.

A List of questions

This appendix contains the list of questions (or statements) presented in the survey. The questions were grouped intro topics which reflect their topic and the structure of this document. This is indicated here in bold.

Demographics of respondents

1. What is your current position? (Figure 1)
2. What is your current affiliation? (Figure 2)
3. What is the duration of your current contract in total? (Figure 3)
4. In which country are you currently employed? (Figure 4)
5. In which country do you reside? (Figure 5)
6. What is your nationality? (Figure 6)
7. What gender to you identify with? (Figure 7)
8. How old are you? (Figure 8)
9. Do you identify yourself as belonging to an underrepresented group within the physics community?
10. Under which criterion do you identify as under-represented? (Figure 18)

Field of work

11. What is your primary field of research? (Figure 19)
12. Are there any other fields of research you are significantly involved in? (Figure 20)
13. In which stage is the experiment you are working in? (Figure 21)
14. Do you work within a collaboration or/and a research group? (Figure 22)

Work within a research Group

15. What is the size of your research group? (Figure 23)
16. Within your research group, how many people do you actively work with during a normal week? (Figure 24)
17. My work in the research group is useful to improve my knowledge, skills and expertise. (Figure 25)
18. There is room for me to express and realise my original/new ideas within the research group. (Figure 25)
19. My work in the research group is too focused on my own research so because of that, I feel isolated from other research aspects of the whole project. (Figure 25)
20. My work in the research group allows me to have an impact on the decision-making of the project. (Figure 25)
21. In my work in the research group, I struggle to have enough resources (e.g. beam time, access to computing power or software, ...) to successfully accomplish my research tasks. (Figure 25)
22. My work in the research group allows me to keep a healthy work-life balance. (Figure 25)
23. My work in the research group gives me enough visibility within the group itself. (Figure 26)
24. My work in the research group gives me enough visibility outside the group. (Figure 26)
25. Working in my research group gives me many job opportunities in similar groups in the same field.(Figure 27)
26. Working in my research group gives me many job opportunities in other research groups.(Figure 27)
27. Working in my research group gives me a high probability of reaching a permanent position in the same field.(Figure 27)
28. Working in my research group gives me a high probability of reaching a permanent position in the industry or private sector in general. (Figure 27)
29. The time I spend doing service work for my research group is... (Figure 28)
30. The time I spend doing service work for my research group is adequate. (Figure 29)
31. The service work I'm doing for my research group is well recognized. (Figure 29)
32. The service work I'm doing for my research group is useful for my career. (Figure 29)

Work within a collaboration

33. What is the size of your collaboration? (Figure 30)
34. Within your collaboration, how many people do you actively work with during a normal week? (Figure 31)
35. How do you consider the size of your collaboration to be? (Figure 32)
36. My work in the collaboration is useful to improve my knowledge, skills and expertise. (Figure 33)
37. There is room for me to express and realise my original/new ideas within the collaboration. (Figure 33)
38. My work in the collaboration is too focused on my own research so because of that, I feel isolated from other research aspects of the whole project. (Figure 33)
39. My work in the collaboration allows me to have an impact on the decision-making of the collaboration. (Figure 33)
40. In my work in the collaboration, I struggle to have enough resources (e.g. beam time, access to computing power or software, ...) to successfully accomplish my research tasks. (Figure 33)
41. My work in the collaboration allows me to keep a healthy work-life balance. (Figure 33)

42. My work in the collaboration gives me enough visibility within the collaboration itself. (Figure 34)
43. My work in the collaboration gives me enough visibility outside the collaboration. (Figure 34)
44. Working in my collaboration gives me many job opportunities in similar groups of the same collaboration. (Figure 35)
45. Working in my collaboration gives me many job opportunities in other collaborations. (Figure 35)
46. Working in my collaboration gives me a high probability of reaching a permanent position in the same field. (Figure 35)
47. Working in my collaboration gives me a high probability of reaching a permanent position in the industry or private sector in general. (Figure 35)
48. The time I spend doing service work for my collaboration is... (Figure 36)
49. I spend adequate amount of time doing service work for my collaboration. (Figure 37)
50. The service work I'm doing for my collaboration is well recognized. (Figure 37)
51. The service work I'm doing for my collaboration is useful for my career. (Figure 37)

Diversity of Physics programs

52. The diversity of physics programs (e.g different experiments, large variety of physics analyses) is a fundamental requirement for a fruitful development of Particle Physics. (Figure 38)
53. Working in experiments that are under construction or in planning is ... for early-career researchers. (Figure 39)
54. Working in experiments that are under construction or in planning offers ... career prospects for early-career researchers. (Figure 39)

Career perspective and planning

55. I am well informed about funding opportunities in the country I'm currently hired. (Figure 40)
56. I am well informed about funding opportunities in Europe. (Figure 40)
57. I am well informed about funding opportunities outside Europe. (Figure 40)
58. I am well informed about career training opportunities. (Figure 40)
59. I am well informed about resources on job application training. (Figure 40)
60. I am well informed on what is needed to advance my career in academia. (Figure 40)
61. I am well informed on what is needed to advance my career outside academia. (Figure 40)
62. I am well informed on where to find advice and guidance regarding my career progression. (Figure 40)
63. I get informed about funding or job opportunities on. (Figure 41)
64. How prepared do you feel for the next stage in your career? (Figure 42)
65. I discuss my career prospects with my supervisor. (Figure 43)
66. I discuss my career prospects with other senior researchers. (Figure 43)
67. I discuss my career prospects with my peers. (Figure 43)
68. What importance do YOU PERSONALLY attribute to the following items for a high-quality researcher? (a)-(k) (Figure 44)
69. From your point of view, what importance does the SCIENTIFIC COMMUNITY attribute the following items for a successful career in academia? (a)-(k) (Figure 45)

70. Thinking about your academic profile, how do you feel about these points? (a)-(k) (Figure 46)
    (a) International collaborations
    (b) Professional mobility
    (c) Publications and bibliographic metrics
    (d) Conference talks
    (e) Activity in boards, panels, etc.
    (f) Networking
    (g) Specialised expertise (e.g. FPGA programming)
    (h) Expertise in a variety of domains
    (i) Service work (in large collaborations)
    (j) Soft skill training (e.g. in project management)
    (k) Outreach

Work-life balance

71. Do you have children? (Figure 47)
72. During which career phase(s) did you have a child (children)? (Figure 48)
73. How important are the following items to you in order to have a good work-life balance? (a)-(f) (Figure 49)
74. To which extent are these aspects fulfilled in your current job? (a)-(f) (Figure 50)
75. In your opinion, to which extent are these aspects fulfilled in your field of research? (a)-(f) (Figure 51)
    (a) Flexible working hours
    (b) Flexible working location
    (c) Possibility to work part-time or of job-sharing
    (d) Good income
    (e) Possibility of long-term planning
    (f) Positive work environment
76. What kind of influence do these items have or you think they would have on the quality and impact of your research? (Figure 52)
    (a) Flexible working hours
    (b) Part-time work
    (c) Job sharing
    (d) Relocation due to new job
77. To undertake a new position in HEP... (Figure 54)
78. Which problems or difficulties did you or your family members encounter when moving abroad for your new position? (Figure 55)
79. I work overtime (not compensating by working less other times). (Figure 53)
80. There is a lot of pressure on me and I feel stressed. (Figure 53)
81. If you are living abroad, would you like to move back to your home country one day? (Figure 56)
82. How did you decide about your current position? (Figure 57)
83. In your career, did you have a break longer than 3 months? (Figure 58)
84. Did you ever change field within physics?

85. Are you considering leaving research in HEP after the current position? (Figure 59)

86. Which factors induced you to consider leaving research? (Figure 60)

Discriminatory or abusive treatment

87. Have you experienced discriminatory or abusive treatment in your collaboration/group? (Figure 61)

88. Are there any measures that would improve your personal situation? (Figure 62)

Recognition and visibility

89. I consider the publication policy implemented in my group/collaboration (such as who signs the publications, in what order, and who is the corresponding author) to be fair. (Figure 63)

90. I consider the policy of representing my group/collaboration at conferences (such as the assignment of presenters) to be fair. (Figure 63)

91. I consider the assignment of positions in my group/collaboration (such as who is the convener of a working group, or member of an internal committee) to be fair. (Figure 63)

92. I believe the most commonly used bibliometric indexes (such as h-index) fairly reflect my work. (Figure 63)

93. I consider the way of awarding prizes in my community to be fair. (Figure 63)

94. I consider the recognition and visibility of my work in my group/collaboration to be sufficient. (Figure 63)

95. I consider the recognition and visibility of my work in my field of research to be sufficient. (Figure 63)

Final questions, feedback and remarks

96. In your opinion, is there any event the ECFA Early-Career Researchers Panel could organize to help you develop your career?

97. What are your most pressing questions in terms of career development? (Figure 64)

98. Do you have any other feedback about this survey?

B Nationality groups

For answers relating to countries, the following groupings are used to define regions with larger statistics:

- Northern Europe: Finland, Sweden, Norway, Netherlands, United Kingdom, Ireland, Belgium, Switzerland, Germany, Austria and Denmark;
- Mediterranean: France, Italy, Spain, Portugal, Greece and Moldova;
- Eastern Europe: Poland, Czech Republic, Slovakia, Slovenia, Bulgaria, Romania, Ukraine, Hungary, Belarus, Lithuania, Croatia, Georgia, Bosnia and Herzegovina, Serbia and Russia;
- North America: United States of America, Canada and Mexico;
- South America: Peru, Chile, Brazil, Argentina, Colombia, Venezuela and Guatemala;
- West / Central Asia: Turkey, Kazakhstan, Israel and Iran;
- South Asia: Pakistan, India and Bangladesh;
- East Asia: China, Japan, Korea and Taiwan;
- Southeast Asia: Vietnam, Thailand and Malaysia;
- Africa: Zambia, Morocco, Egypt, Sudan and Algeria;
- Oceania: Australia and New Zealand.

Countries not included had no responses.

C Direct quotations

In this appendix, direct (and anonymous) quotations from the survey are taken, to provide a more detailed and honest report on the views of some of the ECRs. These do not necessarily reflect the views of the ECFA ECR panel members.

Direct quotations of answers given in response to question 78:"Which problems or difficulties did you or your family members encounter when moving abroad for your new position?" in the open 'Other' box.

- "I declined jobs not to leave my partner";
- "I destroyed any chances I ever had in finding companionship";
- "I never moved (all positions at the same university), to avoid a long-range relationship";
- "I searched for a position where I did not need to move, because my relationship is more important to me";
- "I would not like to move because of family and relationship";
- "leaving academia due to the contemporary mobility requirements";
- "my partner moved with me, and now we refuse to be separated";
- "difficulty in maintaining long distance relationships";
- "I cannot ask my partner to quit his/her permanent job to follow me";
- "I have managed to avoid moving since finding a partner and having children, but this has come at the expense of my career";
- "long distance relationship with partner";
- "missing intimacy with my partner";
- "partner was/is herself completing a PhD in another country";
- "relationship problems due to long distance";
- "relationships ultimately ended due to relocation";
- "long distance relationship over a decade";
- "having to relocate every couple of years, difficulties in calling a place home";
- "not enough documentation on the paper-work to be done after moving to a different country/continent";
- "missing support from family for childcare";
- "huge amount of time for the logistics of each move";
- "administration: registration, insurance, bank account, ...";
- "difficulties with bureaucracy being a foreign resident in the country";
- "Too difficult to find housing, zero support is given to PhD students";
- "residency/visa applications";
- "moving alone mid-pandemic was not the greatest experience".

Direct quotations of answers given in response to question 86 "Which factors induced you to consider leaving research?" in the open 'Other' box:

- "competitiveness, constant pressure and stress, lack of acknowledgement, lack of guidance in projects";

- "competition for PhD places";
- "difficult career path forward";
- "do not want to move abroad";
- "double rent and flights are very expensive on an average salary. Children living apart is very difficult";
- "geographical restriction of postdoc and professor market";
- "having to take a break (illness, child birth,...) can be a serious problem (e.g. short - term contract does not get extended)";
- "I don't want to relocate to an other country";
- "I have been applying for permanent faculty positions over the last two years. The market is very rough. I personally felt that my work is not valued and, in several hiring decisions, it is connections and power dynamics which play a major role. At some point, I felt I had enough of this broken system and it is time to explore new directions";
- "I want the person who pays my salary/hires new people to also be the person who sets my work priorities. Them being separate really sucks";
- "I want to decide where to live based on the place, not based on where I get a job";
- "lack of motivation to pursue research in the field";
- "limited job opportunities";
- "long term HEP prospects are not very good because of political and economical crises";
- "moving to a place with gay-friendly social life";
- "my research does not seem to have direct impact to the immediate issues of society";
- "need to follow next another passion of mine and want to spend more time with other people";
- "no chance for a growth because of useless supervisors";
- "perspective";
- "pre-existent psychological issues largely amplified by the pandemic";
- "staying in my home country";
- "the prospect of moving to a different country every two or three years to maybe then get a permanent position when I'm forty. Considering the amount of doctoral candidates and the amount of permanent positions, it is quite likely that I won't get a permanent position anyways, so I might just leave straight away";
- "this year I'll be finishing school, so I'll start 9-5 job in field of laser physics near the place I live";
- "trying and learning something new";
- "war";
- "academia is a terrible field with terrible prospects";
- "change research subject to different than HEP";
- "lack of self-realization";
- "lots of bureaucracy, not plausible situation with funding of Fbasic research, small chance to get a grant";
- "not enough available tenure-track positions";
- "society".