

# Graduate Student Survey for the NSAC Long Range Plan Process 2023

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## Abstract

As part of the Nuclear Science Advisory Committee (NSAC) Long Range Plan process, a survey of graduate students was undertaken. This white paper summarizes the survey process, responses and results, and potential actions to mitigate the reported challenges. The survey demonstrated financial hardship and precarity in the graduate student community and that, while progress has been made, full inclusion has not yet been achieved in the nuclear physics community. Recommended actions include: increasing graduate research student remuneration; developing, implementing and broadly disseminating agency policies on medical and family leave; aiding inclusion through enhancing agency support for the development and implementation of community agreements and the delivery of active bystander and inclusive mentoring training; and leading by example by developing community agreements for national laboratories and user facilities.

## 1 Introduction

The Nuclear Science Advisory Committee (NSAC) was charged by the National Science Foundation (NSF) and Department of Energy (DOE) to produce a new Long Range Plan (LRP) in 2022. The 60-person LRP writing committee was formed from NSAC members and others in the community, then organized into subcommittees for each chapter. The workforce chapter subcommittee was broadly tasked to address issues

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of workforce recruitment, development, and retention, including aspects of diversity, equity, and inclusion (DEI) in Nuclear Physics. The subcommittee took into account workforce and DEI input from the various white papers which had been submitted to the LRP writing committee from town halls and community reports, such as [1, 2], but it swiftly became apparent that more data were needed. In particular, faculty were surveyed on aspects of graduate student remuneration; and a survey of nuclear science graduate students was undertaken to establish what needs and challenges they identified in their own experiences in the field. The purpose of this document is to record the results of this graduate student survey in order to provide a fuller picture of the basis upon which the recommendations in the LRP were formed.

As this survey was rapidly assembled to determine how best to support graduate students in the LRP workforce recommendations, the survey was intended to be an information-gathering rather than a research process. Hence no Institutional Review Board (IRB) review or approval was sought. This white paper simply summarizes the responses to this survey as analysed by a group of concerned nuclear physicists with no formal training in social science methodologies on a best-effort basis, and provides some suggested actions. We would encourage the community to engage in a full climate study, including and extending beyond the graduate student body, in advance of the next LRP process. This should involve collaboration with qualified physics education researchers and social scientists, and be submitted for IRB approval, in order to facilitate careful study of the climate and needs of the community to inform the development of the next LRP.

## 2 Survey creation and dissemination

The graduate student survey was discussed in the workforce subcommittee, and then drafted in a Google form. The subcommittee reviewed the form based on experience with their own students and / or in administrative roles, and provided feedback before the survey was finalized in small group discussions at the 2023 APS April Meeting. The questions in the survey are described in Appendix B and can be viewed, in the order they were presented to survey respondents, in Figures 14 to 18 in Appendix B. The invitation to complete the survey was then distributed via email to contacts at each institution with nuclear physics funding in the US on April 22, 2023 with a request to share with all current graduate students performing nuclear science research. A follow-up reminder was sent on May 16 to all CEU research mentors, and additionally to the full LRP writing committee to maximize the dissemination of the link. See Appendix A for the emails sent by the workforce subcommittee chair.

## 3 Data collection and cleaning

Data was gathered from April 22, 2023 continuously until the Long Range Plan Resolution Meeting which occurred on July 10 - 14, 2023.

To allow the full analysis of the data set in advance of a workforce chapter subcommittee meeting, data received up to that point were downloaded on the evening of May 22, 2023. That data set initially contained 247 responses. Five of these responses were completely identical and were submitted within less than 30 seconds of each other, indicating that they were accidental re-submissions of the same single response. Four of these instances were removed from the data set, leaving 243 responses. No other responses were removed from consideration. All graphs and figures in this document and all graphs and figures which were presented to the LRP writing committee are derived from the analysis of this data set.

At the Long Range Plan Resolution meeting in July, the presentation of the workforce and DEI recommendations was supported by the same body of information that was shared with the workforce subcommittee and had motivated the resolution proposals, hence graphs based on the 243-respondent data set from May 22 were presented. By the evening of July 10, 34 additional responses had been received. In addition to the graphs from the 243-response set, some quotes extracted from the long-form responses to the questions were presented within the closed forum of the LRP Resolution Meeting, some of which were derived from these additional responses received after the data had been analyzed to produce the distributions and graphs.

The form was completely anonymous, but to further protect those who submitted responses, we will not include direct respondent quotations in this public document. We will, however, summarize general themes and issues which were raised in those long-form textual responses. Note that while we address respondent

demographics in the next section, those questions were asked at the very end of the survey (see Appendix B). Here they are presented first as they are employed in the analysis of the foregoing.

Throughout this report, where uncertainties are shown, they are calculated assuming simple counting statistics: that the uncertainty in a given sample  $N$  who answered a specific way is equivalent to  $\sqrt{N}$ , and that the fractional uncertainty is thus  $(\sqrt{N})/P$ , where  $P$  is the total population which responded to that question.

## 4 Respondent demographics and coding

The only compulsory question on the form asked the students about their research field in order to ensure that only nuclear science graduate student responses were accepted (see Figure 14). Of the 243 respondents, 193 identified themselves as nuclear physics experiment students, 35 as nuclear physics theory, and 9 as nuclear chemistry. An additional 6 students identified themselves as: applied nuclear physics; both nuclear theory and experiment; NP software experiment, phenomenology; nuclear astrophysics; nuclear physics other; and nuclear/radio chemistry; which were collectively classified as “Other”, but all fell into the classification of nuclear science necessary for their responses to be included in later analyses.

In all of the demographic questions (Figure 18), which were the final questions on the survey, participants were allowed to enter their own textual input. These responses were then coded into discrete categories for proper analysis. For the most part, the coding was clear, but there were a few instances where it was necessary to exercise judgement.

In the case of race and ethnicity answers (Figure 1), Latino, LatinX, Hispanic etc. were coded as one group. Asian, Chinese etc. were coded as a single group. White, Caucasian etc. were identified as a single group. However, in cases where participants identified themselves as mixed race, African American, Black, Middle Eastern, Palestinian etc., they were entered into an “Other” classification as the number of individuals in each category was too small to allow meaningful data analysis in any other way. In the final analysis, typically race / ethnicity-based analyses were conducted by using a white non-Hispanic / non-LatinX sample compared to all others who had declared some other race / ethnicity. The 22 individuals who did not disclose their race or ethnicity were omitted from such analyses unless explicitly stated. After coding, the race and ethnicity distribution can be seen in Figure 1. Our survey did not account for visa status. According to the NSF Survey of Earned Doctorates, an average of 26% of Ph.D. recipients in the past 10 years were non-white. The DOE Nuclear Physics Workforce Survey in 2021 indicated that 46.2% of PhD recipients were non-citizens. It is thus impossible to tell if our respondent sample skews more or less diverse than the general population of nuclear PhD students at 44% as only US citizen degree recipients are asked their racial or ethnic status in the NSF survey. However, should the response rate be perceived as disproportionately diverse, this may be because individuals from underrepresented groups are more aware of climate challenges and may experience more hardship, enhancing their motivation to respond to the survey. We would encourage NSF to collect demographic data from all PhD recipients, and that any future climate survey account for visa status of respondents as a potentially important variable to analyse and benchmark the data against the only national-level information we can currently access.

In the case of gender (see Figure 2), when investigating potentially gendered effects, we typically analysed declared men’s as contrasted to declared women’s responses. There were three individuals who identified outside of the gender binary and sixteen individuals who chose not to disclose their gender. These individuals were excluded from gender-based analyses due to the small sample size or unknown gender identity. The gender breakdown of respondents is shown in Figure 2. Again, as one can see, women are over-represented in the survey responses compared to the general nuclear graduate student population, where 20% of PhDs in physics generally are awarded to women<sup>1</sup>.

The question on LGBTQ+ identification (Figure 18) was a simple multiple choice selection so required no further coding. The responses to that question can be seen in Figure 3.

As there was some question of whether, for example, questions of financial hardship could be related to household size or type of household location, we asked about the type of location in which the student’s institution was situated (Figure 18) and for the number of individuals in their household (Figure 17). In the case of location, 16 students selected “Other”, rather than the already given categories (major metropolitan

<sup>1</sup><https://www.aip.org/statistics/reports/trends-physics-phds-171819>

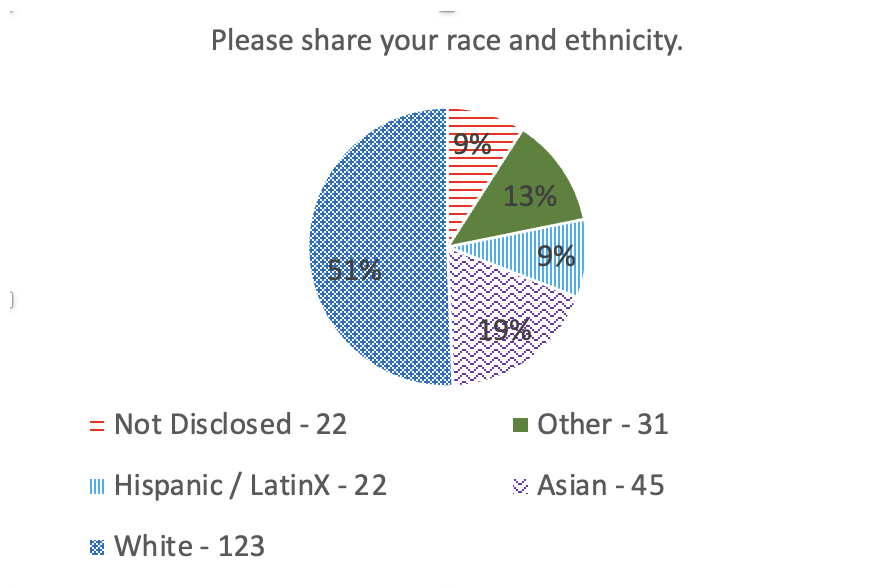


Figure 1: Distribution of respondent race and ethnicity.

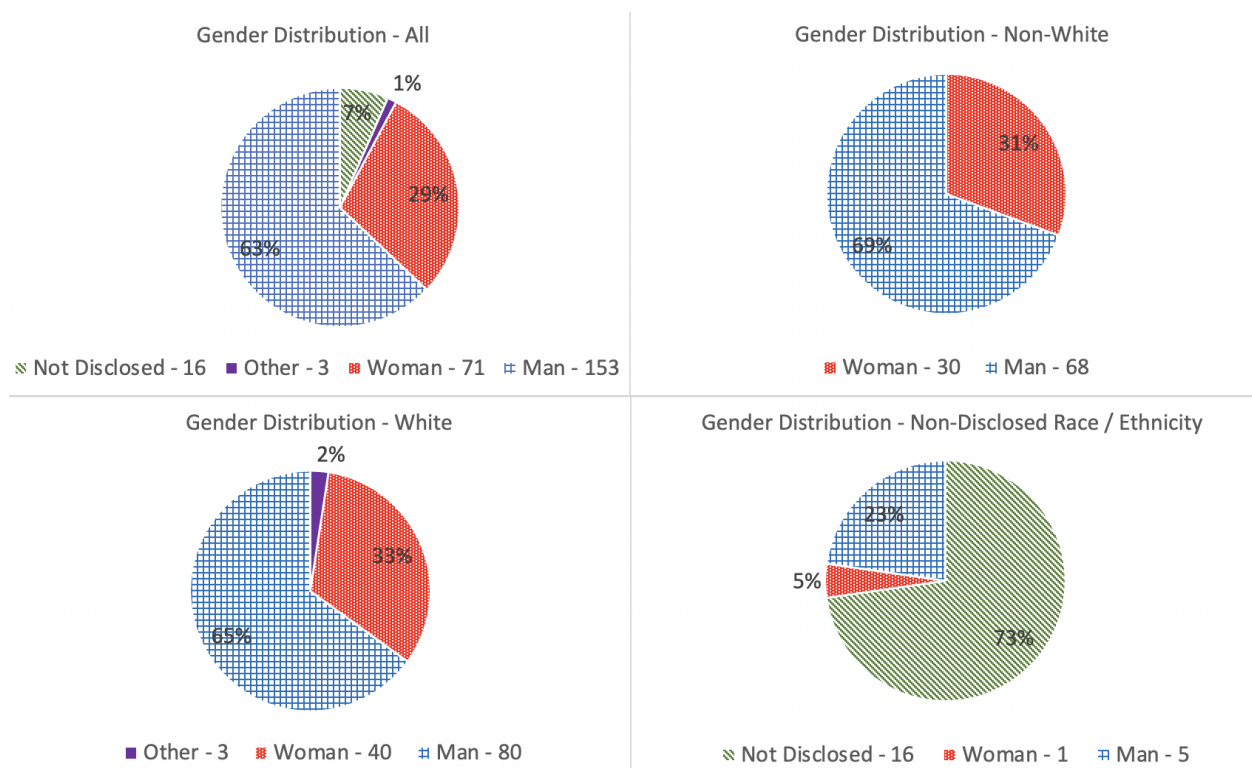


Figure 2: Respondent gender identity, broken down by race and ethnicity.

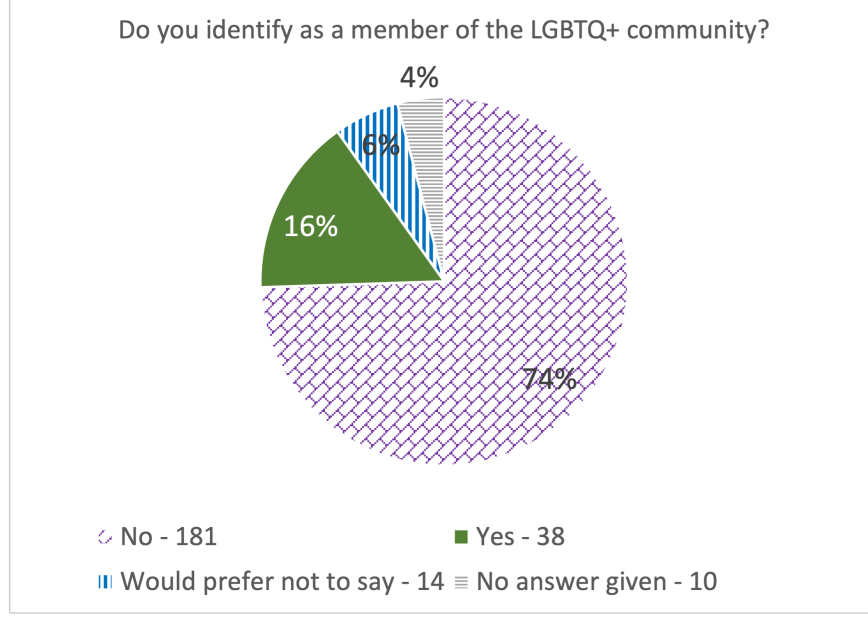


Figure 3: Respondent self-reported LGBTQ+ identity breakdown.

area, urban area, college town) recording a variety of situations: suburban, specific locations, split location between university and national lab in vastly different location types etc. These were all simply classified as “other” and treated distinctly from those who chose not to disclose. The results of this treatment can be seen in Figure 4.

For the question on household size (Figure 17) we now realize we should have explicitly said “include yourself in this number,” as several individuals answered “0”. In coding these responses, we converted all zeroes to 1, but the question remains as to whether when the respondents gave a number of  $n$ , whether that number should really be  $n + 1$  when one includes the respondent. The responses modified as described above can be seen in Figure 5. From these data, less than 50% of those who responded to the question indicated that they were living in a single-person household. Most studies of graduate support assume that a given PhD student is simply supporting themselves, but the numbers from this sample clearly indicate that may not be the norm. In some cases, a two-person household may contain multiple adults who have income sources and can improve the circumstances of the household, in some others, issues such as visa conditions may mean that the graduate student support is the only income source, leading to additional hardship. Both of these configurations were reported in the long-form comments described below.

## 5 Initial questions

After establishing that students belonged to the appropriate sampling pool we asked them a series of questions to help understand their situation, outlook, and mental health status, see Figure 15 for the questions and Figure 6 for the response breakdown. It was very positive to see that to the statement, “*I feel I belong and am supported in my department,*” 97% of respondents selected “*yes, sometimes*” or “*yes, frequently*”. Similarly for “*I feel supported by my advisor / mentor,*” 68% selected “*yes, frequently*” and 29% selected, “*yes, sometimes*”. Only 7% of respondents answered “*yes, frequently*” to the statement, “*I struggle to fulfill my research responsibilities,*” and 55% answered “*yes, sometimes*”. The challenging nature of a nuclear PhD makes some struggle likely, but we should monitor this number going forward. 74% of students answered yes, to the statement, “*I am concerned about my future,*” 25% of those are frequently so. This may be exacerbated by the fact 76% of respondents expressed that they sometimes or frequently experienced mental health challenges. That such a high fraction of nuclear physics graduate students experience mental health challenges is troubling, although we made no attempt to gauge the severity of those challenges. That a

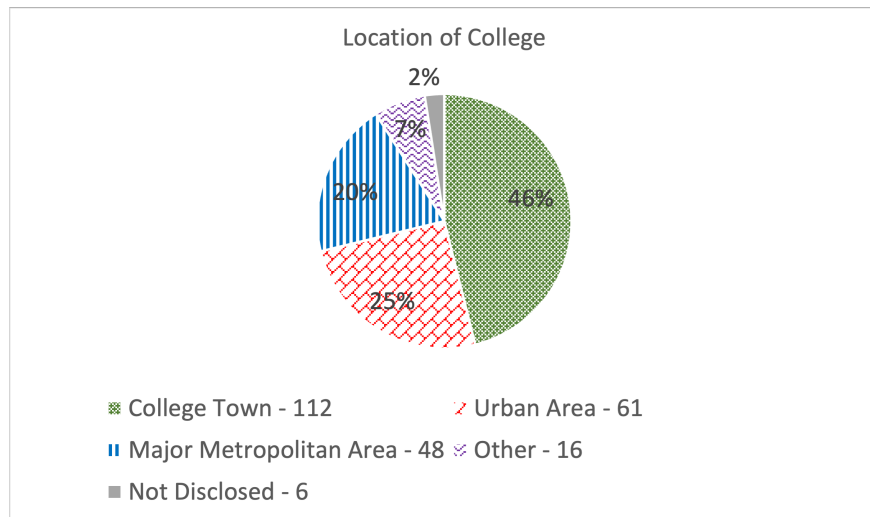


Figure 4: Respondent institution location type.

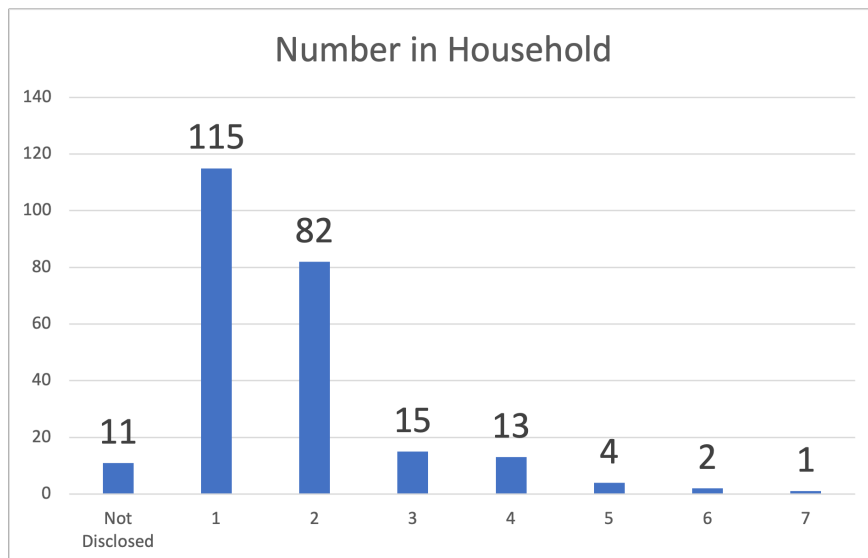


Figure 5: Reported number of members in the respondent's household.

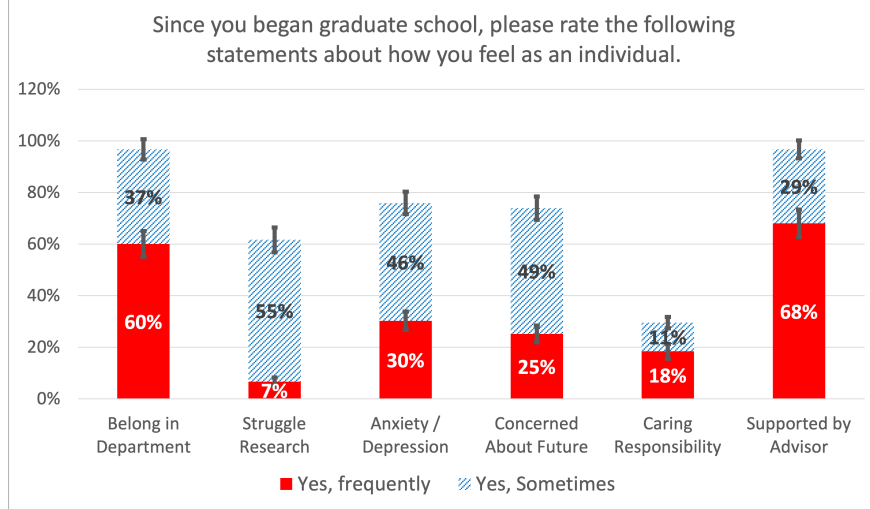


Figure 6: The percentage of students responding *yes, sometimes* or *yes, frequently* to questions on their situation, support structures, and mental health.

population of (mostly) young people are experiencing such challenges is perhaps unsurprising within the context of the ongoing national conversation about the mental health of teens and young adults. But the mental health of students who have chosen research — a sometimes solitary and frequently stressful pursuit — was undoubtedly worsened by their isolation during the COVID-19 pandemic. Finally in this group of questions, 29% of respondents reported that they had some caregiving responsibilities. That almost one third of the graduate student community has caring responsibilities may come as a surprise to many. The burden of caring for a family member or spouse is often not visible to peers or supervisors, but can place a substantial load on the caregiver.

## 6 Inclusion in the nuclear physics community

We next asked a series of questions designed to assess inclusion in a nuclear context. To keep things as simple as possible, we asked, “*Since you began graduate school, have you been made to feel uncomfortable due to your gender, race, sexuality, religion, socioeconomic status, or other aspects of your identity or status, in the following settings?*”. The options offered and the response can be seen in Figures 7 and 15, respectively. We note that exclusion occurs least frequently within the research group, although 14% of respondents have reported being made to feel uncomfortable due to their identity in that setting. In classes, within their department, and in another professional setting such as a conference, 21% to 25% of respondents have been made to feel uncomfortable due to their race, gender, ethnicity or other aspects of their identity or status. These are not encouraging numbers, and the community needs to take steps to address these issues and behaviours.

To try to understand if specific groups within the nuclear community experienced this more than others, we counted the number of times each respondent had answered *yes, frequently* or *yes, sometimes* to each of the four questions, and plotted this frequency distribution separately for those who identified as men as compared to women (Figure 8) and for those who identify as LGBTQ+ and those who do not (Figure 9). We found that 55% of LGBTQ+ physicists had been made to feel uncomfortable due to their identity or status as opposed to 36% of non-LGBTQ+ physicists, which accords with findings in the American Institute of Physics (AIP) LGBTQ+ in Physics Report [3]. For women the results were even starker with 70% of women having had such a negative experience as compared to 24% of men. This further evidences the Aycock *et al.* [4] findings from a survey of CUWiP participants. These survey results make it very clear that discrimination is still an all-too-frequent experience for groups underrepresented in the community. Note we did not specifically ask for further details of these incidents, but the literature [4, 3] and the long form comments (Section 8) give an indication that these can range from microaggressions to physical harassment.

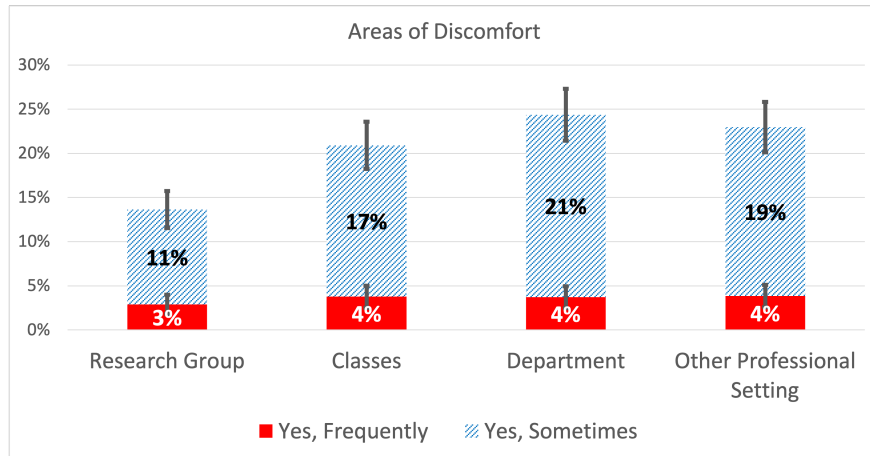


Figure 7: Answers to, “Since you began graduate school, have you been made to feel uncomfortable due to your gender, race, sexuality, religion, socioeconomic status, or other aspects of your identity or status, in the following settings?”

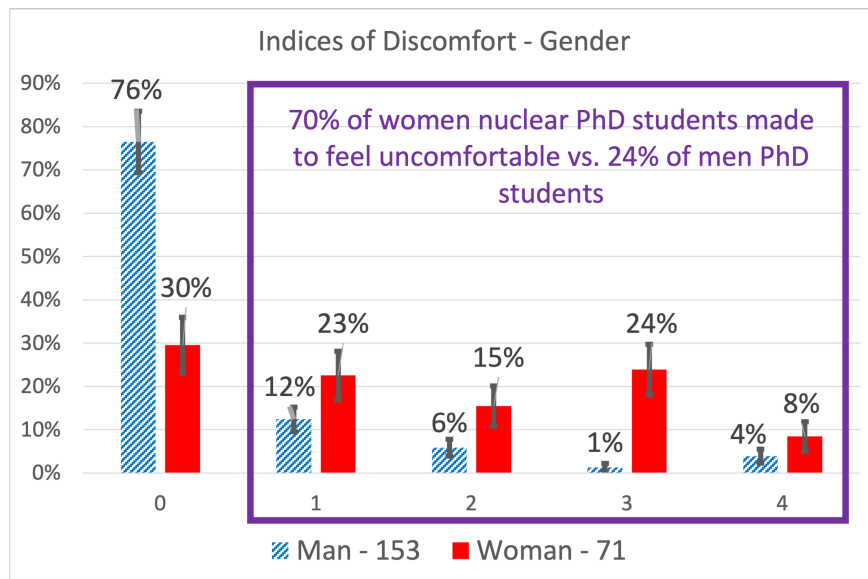


Figure 8: The number of times that the students responded *yes, sometimes* or *yes, frequently* when asked about professional situations in which the respondent was made to feel uncomfortable due to their gender, race, sexuality, religion, socioeconomic status, or other aspects of their identity or status, analysed by reported gender.



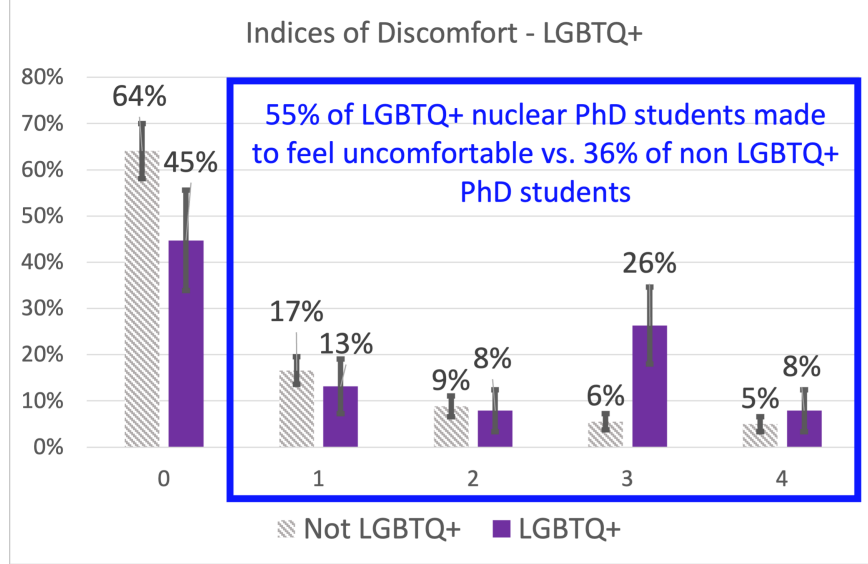


Figure 9: The number of times that the students responded *yes, sometimes* or *yes, frequently* when asked about professional situations in which the respondent was made to feel uncomfortable due to their gender, race, sexuality, religion, socioeconomic status, or other aspects of their identity or status, analysed by reported LGBTQ+ identity.

## 7 Financial well-being of the nuclear PhD student community

In order to ascertain the financial situation of the graduate student population, questions which targeted specific basic financial needs (Figure 16) were asked and plotted in Figure 10. Students struggled most to cover healthcare (45%) and housing (39%) costs, followed by utilities (33%) and basic transportation (29%). Twenty-eight percent (28%) of students reported struggling to afford the tools or travel they need in order to complete their academic and / or research responsibilities. To ease the burden faced by almost 1/3rd of nuclear science students advisors should work with institutions to ensure their travel expenses are directly paid, and/or travel advances are provided. Otherwise students frequently have to carry these costs — which may be equivalent to an entire month of their pay — for weeks or even months until reimbursement arrives. Twenty-three percent (23%) of respondents struggled to pay for food, and a similar number for work transportation. In addition, 16% reported having unreliable internet. In a follow-up question, 12% of students reported having an unreliable computer to do coursework or research. This answer varied by less than 1% when separated by race.

In order to see whether some smaller number of students was struggling across the board or a larger number of students were struggling in a variety of areas, we counted the number of times that each respondent answered *yes, sometimes* or *yes, frequently* to each of the eight categories of financial hardship (see Figure 11). In so doing, we found that 65% of survey respondents had struggled to meet at least one of these basic financial needs. Even were one to assume that no other students in the community beyond these respondents were experiencing such financial hardship, 159 students struggling to meet their basic housing, healthcare, transportation and food needs is clearly unacceptable.

In order to investigate possible correlations with race, we followed the same procedure described above, this time separating the distributions into that for students who identified as white and non-Hispanic, and that for all others who identified as non-white and / or Hispanic, see Figure 12. There does appear to be some racial / ethnic correlation of financial hardship: 73% of non-white / Hispanic nuclear PhD students have experienced at least one form of hardship, compared to 59% of white, non-Hispanic students. This accords with the more detailed American Physical Society TEAM UP Report [5].

One possible consequence of financial hardship is that graduate students may feel forced to take on external employment. We asked about this (see Figure 17), followed by a question to ascertain how many hours of work those who had engaged in external employment had taken on in addition to their university

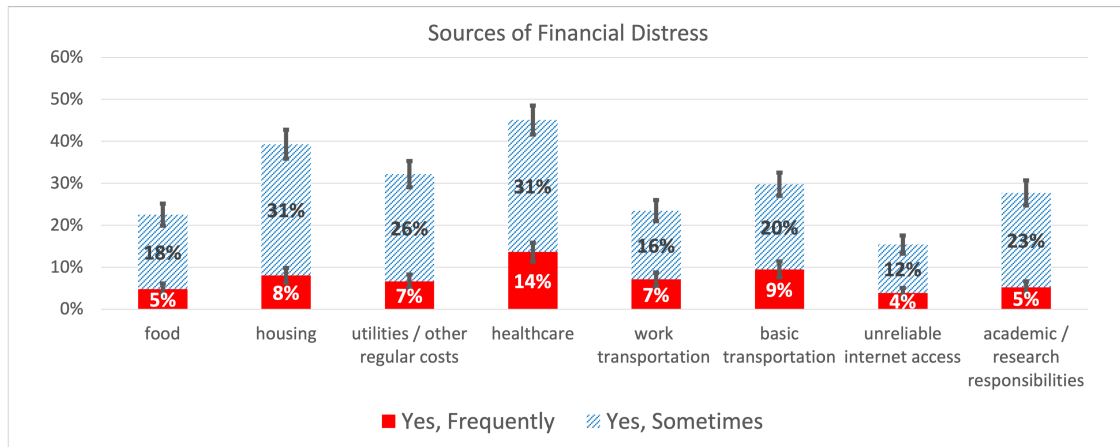


Figure 10: The percentage of students responding *yes, sometimes* or *yes, frequently* when asked whether they had struggled to meet various categories of basic living costs.

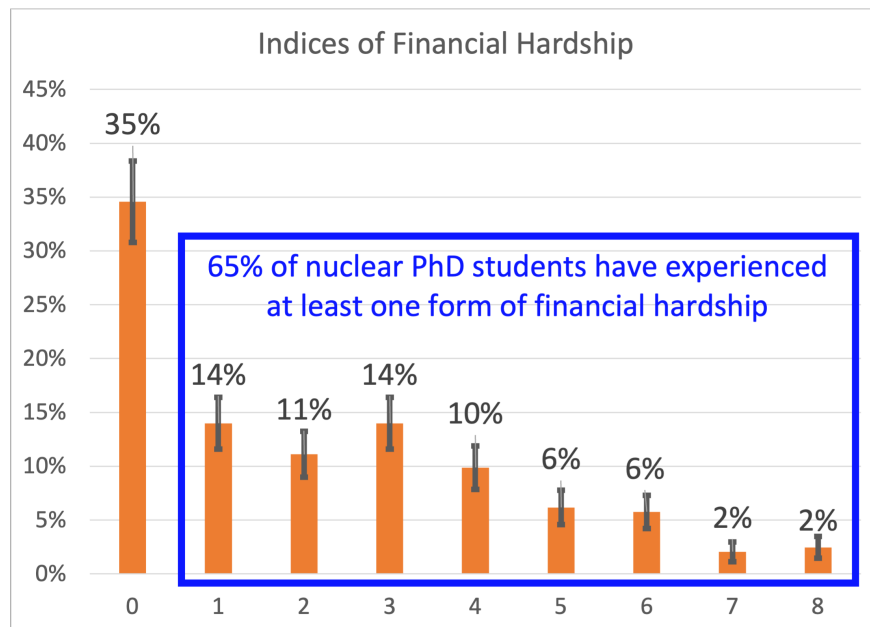


Figure 11: The number of times that the students responded *yes, sometimes* or *yes, frequently* to having struggled to pay for basic necessities such as rent, healthcare, food and transportation.

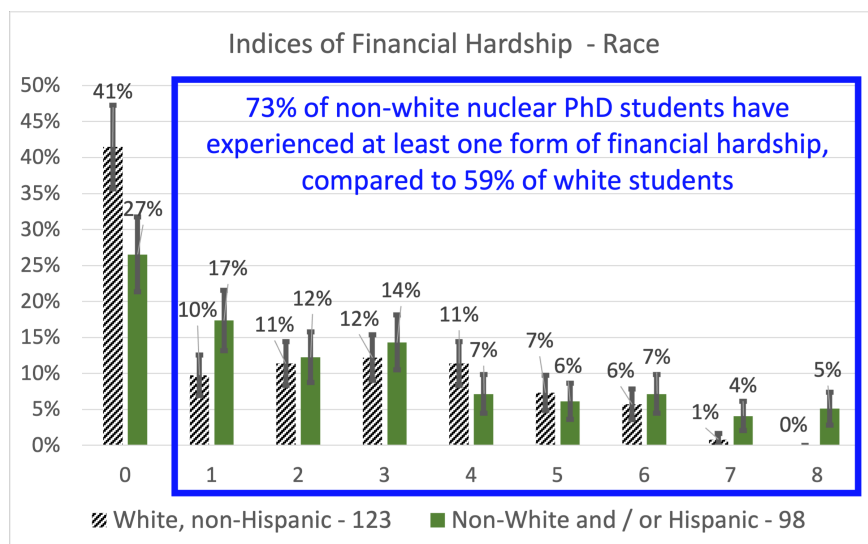


Figure 12: The number of times that the students responded *yes, sometimes* or *yes, frequently* to having struggled to pay for basic necessities such as rent, healthcare, food and transportation, as a function of reported race and ethnicity.

and degree responsibilities. The responses, shown in Figure 13 demonstrate that ~23% of students (55 respondents) have taken on outside work. Of those 55, 45 chose to answer the follow-up question, revealing that 36% of those responding were working 15 hours or more per week externally in addition to their university and research responsibilities. As nuclear scientists frequently work in hazardous environments, these additional working hours could become a safety issue as over-tired students are more likely to make mistakes, and could endanger both personnel and experiments. Since the "how many hours" field was an open text field, several students entered that visa conditions prevented them from taking on additional work that they really needed due to financial hardship.

## 8 Summary of open comments

Students were able to provide comments and concerns in the final question before the demographic information described in Section 4: *"Is there anything else you would like the committee to think about or consider in the Workforce Development section of the NSAC Long Range Plan?"*. The responses to this question were many and varied. Of the 277 responses received by July 10, 2023, approximately a quarter gave a substantial response. Due to the public nature of this white paper and to further ensure anonymity for respondents, we will not share direct quotes here, but instead summarize general themes which arose.

As one could anticipate from the earlier responses, more than a quarter of these textual responses raised the need for more adequate remuneration. However, the responses also revealed specific nuances of the financial challenge. Major issues were raised by students with children, family members to support, or other caregiving responsibilities. In particular the need for childcare support to attend conferences was raised. International students mentioned additional challenges as they were prevented from earning additional income through outside work, and some had spouses who were also prevented from working by visa conditions. Some students reported not having or being able to afford a computer which met their research needs. A large number of students described the precarity of their situation, that one unplanned modest additional expense such as a car repair or hospital bill would be catastrophic. There were also some specific pinch points which were highlighted by respondents: the cost of relocating to start graduate school; travel required for e.g. a conference or experiment that the students had to pay in advance; summer support being non-existent or vastly reduced from semester levels; and students from an area of lower cost of living being relocated to a national lab where the cost of living is far higher.

Respondents did not only use this field to highlight their own situations. Several students recorded that

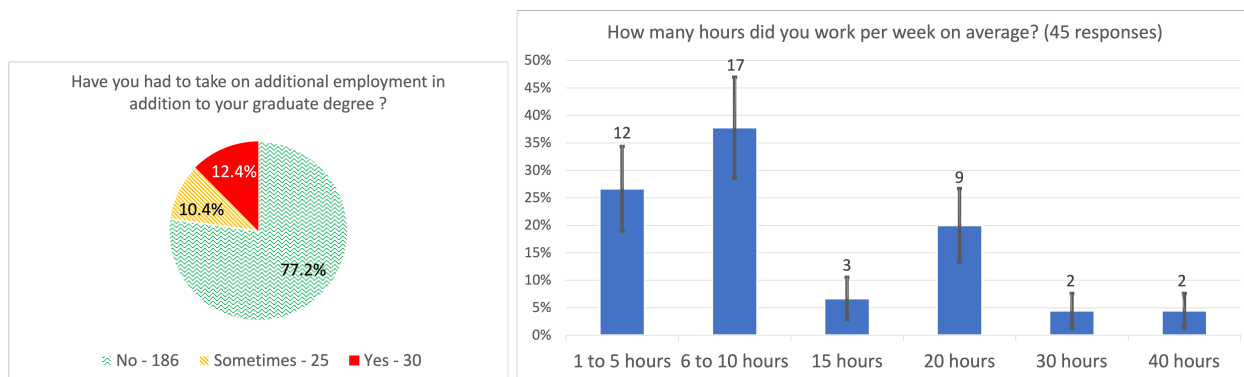


Figure 13: External employment of graduate students: Left: ~23% of students report having to take on additional paid employment outside of their university responsibilities. Right: The distribution of hours worked for the 45 students who responded to the question. The lower two bins represent data ranges, the upper four record exact number of work hours reported.

they did not have financial challenges only because they were receiving significant financial support from parents or spouses. Several of those students reflected upon how this could prove challenging for students without such support, such as first-generation or under-represented students. In their responses, some students emphasized that the results of the survey will suffer from survivorship bias as only those remaining in the community are here to respond. Many students reported seeing friends and colleagues leave the field due to financial and climate-related challenges, and responses from those missing students are therefore not captured here.

Many climate issues were identified by respondents: these ranged from micro-aggressions, such as misgendering of trans individuals, to incidents such as differentially harsh treatment of international students by national lab administrators, to assault of female students. Students specifically reported incidents of bias due to their gender or gender expression, nationality and religious beliefs. Some respondents perceived Codes of Conduct to be disingenuous, as, in some cases, harassment reports were not handled effectively and poor situations were reported to continue and harassers faced no consequences. Trans students in particular reported feelings of isolation. Students requested better DEI training for the broader community. Some students reported experiencing very stressed, politically fraught atmospheres in their local group, or in their broader research field. Some even reported bullying by their supervisor or other group members.

The dual status of graduate students as both students and staff exacerbates both financial and climate challenges. Students reported feeling stuck in the gap and suffering with no formal vacation, sick leave, or family leave policies in many cases, and they frequently also have poor healthcare options. They reported being unable to access necessary mental health care, unsure how they could take time off they need, and, in some cases, being forced to work on holidays such as Christmas or Thanksgiving Day by their supervisors. There was a perception that their dual status left them with very few rights, benefits or avenues to seek redress.

There was evidence in the responses of lingering COVID effects. Childcare challenges have been exacerbated by post-COVID school attendance policies. Some students were also concerned by the complete lack of COVID safety measures in place in the workplace and at conferences. They raised this as an inclusion concern for vulnerable community members or those who are caring for vulnerable individuals.

Finally, students requested more career guidance to assist them in their professional preparation, in particular, transparency around postdoc, faculty, and industry career paths.

## 9 Summary and outlook

277 students took the time to complete the survey and we feel that their voices must be heard and acted upon. There is no definitive census of the nuclear science graduate student community, but estimates range between a population of ~700 to ~1070 students, meaning the survey sample is somewhere between 25%

and 40% of the community. The graduate student survey results made very sobering reading. While it is heartening to see that students felt most at home in their research groups and that the vast majority of students felt supported by their advisor, many large and challenging issues remain to be addressed. Here we summarize the main observations and then present suggestions for effective practises which may help to alleviate some of these issues. While this survey was created to inform the LRP process, and therefore the initial actions suggested by this survey are directed at the funding agencies, there are many aspects of the identified needs that the agencies alone cannot resolve. To that end, we also provide suggested actions for PIs and the broader nuclear physics community.

## 9.1 Observations from the survey

- 65% of graduate students (159 individuals) reported facing challenges to meet basic costs such as accommodation, healthcare, transportation and food. Even if one assumes these 65% of survey respondents are the only nuclear graduate students facing these challenges, they represent a significant fraction of the community due to the high survey response rate.
- 28% of graduate students reported struggling to afford tools and/or travel needed to fulfil their academic and research responsibilities.
- 76% of students reported facing mental health challenges.
- Students reported feeling financially precarious, and unable to meet even a modest sudden unexpected cost without severe consequences.
- Students who were able to make ends meet frequently reported achieving this through substantial support from partners or family members, observing that they do not know what would happen if their support networks were not able to meet those costs, as is often the case for first generation or students from underrepresented groups.
- This concern was reinforced by the analysis of the data on financial hardship which demonstrated that non-white and / or Hispanic students suffered more financial challenges than white, non-Hispanic students (Figure 12). This accords with [5].
- Students reported that their dual status as employee and student left them uncertain as to what recourse and support was available to them when faced with challenging circumstances such as personal or family illness, caring needs etc.
- 70% of women reported being made to feel uncomfortable in a professional setting due to their race, gender, or other component of their personal identity or status, as opposed to 24% of men (Figure 8). This accords with [4].
- 55% of LGBTQ+ physicists reported being made to feel uncomfortable in a professional setting due to their race, gender, or other component of their personal identity or status, as opposed to 36% of non-LGBTQ+ physicists (Figure 9). This accords with [3].
- Students requested improved DEI training for the community, and indicated that more effective enforcement of Codes of Conduct was necessary, with some reporting experiencing discrimination based on gender, religious beliefs, and nationality, leading to an unwelcoming, or even dangerous, environment.

## 9.2 Possible agency actions

Some of the most urgent and pressing needs of the graduate students are clearly financial in nature. While decisions on graduate compensation are subject to institutional policy and practice and sometimes collective bargaining agreements, *a major hurdle to progress in this area could be removed were the agencies to support an increase in graduate student compensation. The increase should meet the cost of living for a single person in the location the student must reside.* This must be achieved without contraction in the size of the graduate student workforce, or the number of opportunities for students would

be reduced, which would have a detrimental effect both on the scientific output and likely on the diversity of the graduate student community.

Another measure to reduce precarity may be to make emergency funds available as APS has done for National Mentoring Community Mentees in the BEAM fund<sup>2</sup>. Studies show that even small emergency awards can help student completion rates and make them feel valued and included in the community. If not rolled out nationwide, this could be considered, at a minimum, for students from the RENEW program<sup>3</sup> as they move into graduate study without the fiscal safety net available to others.

The dual status of graduate students, as established in the Code of Federal Regulations 200.400(f) [6] has resulted in great uncertainty on issues such as paid medical and family leave policies, and the allowability of relocation support or childcare costs to enable conference attendance. ***We request that the agencies develop clear policies on such issues and communicate them broadly and effectively to enable institutions and PIs to support their graduate students in an inclusive manner.*** There exists a medical and family leave policy for NSF Graduate Research Fellowship Program awardees [7] which could be used as a model.

It was clear from the survey that both women and LGBTQ+ physicists do not feel fully included in the nuclear physics community and that issues such as harassment and microaggressions persist. If we truly want to make a career in nuclear physics available to all in society and draw upon the full pool of available talent, this must be resolved. Nuclear scientists regularly work long hours late at night in pairs or small groups in isolated situations. Collaborators can stem from a wide variety of institutions, countries, and cultural backgrounds. It is important that all members of the collaboration working together in such circumstances have a shared understanding of acceptable behavior and that effective reporting pathways and appropriate resolution pathways exist, should that understanding be breached. Community agreements, wherein acceptable conduct is outlined, and reporting and resolution pathways are defined, can help to address issues of climate and inclusion [8].

Many collaborations and institutions have shown interest in community agreements but have struggled to implement them in trying to define reporting pathways, investigative mechanisms and appropriate mechanisms of restorative justice. ***Agency support could allow the employment of individual with the requisite expertise to assist in these challenges: providing training, support, and advice to physics entities seeking to devise and enact community agreements.*** They could also collect effective community-agreement-related practices and, over time, form a repository of successful community agreements that could be used as templates and examples. In order to lead by example, and push for important and effective change, ***all national labs and user facilities should devise and implement effective community agreements which apply equally to all staff, students and users at the lab or facility.***

In general, we recognize that the community needs support to fulfill our collective ambition to ensure equal opportunity to engage in nuclear science research for all. Training in active bystander and inclusive mentoring strategies, delivered in accessible ways, such as added to conferences and other community gatherings, could be a very effective way to equip the community for these challenges. To achieve this requires fiscal sponsorship. ***We recommend the agencies support the development and delivery of inclusion and mentoring training in strategic venues to equip PIs to create an inclusive environment with effective and supportive mentoring.***

### 9.3 Community actions

Due to the inherent power dynamic between a supervisor and PhD student, there is a high probability that students experiencing challenges, be they financial-, mental-health-, or climate-related, may not feel comfortable to ask for help. Thus we encourage the community not to wait until you hear there are challenges, but to work proactively to ensure that all students feel supported, included, and safe, to enable these vital members of our community to thrive and do their best work. We suggest the following actions:

- As far as possible, ensure you are paying your students a wage that meets the cost of living for the area in which they have to live to fulfil their nuclear science duties (see [9]).

<sup>2</sup><https://www.aps.org/programs/minorities/nmc/nmcbeam.cfm>

<sup>3</sup><https://science.osti.gov/Initiatives/RENEW>

- If it is not possible to increase remuneration appropriately when relocating your student to an area with a higher cost of living for their research, investigate covering their housing costs or providing some other source of relief.
- As far as possible, meet travel costs directly, or provide students a cash advance to cover all work-related travel / conference expenses without requiring the student to pay and then wait for reimbursement.
- Pay students evenly throughout the year to avoid summer hardship.
- Ensure that all students have a reliable computer.
- Discuss issues of inclusion in your group meetings, proactively pointing students towards resources such as employee resource groups, benefits guides, and how to access family and medical leave.
- Discuss issues of healthy work-life balance in your group, and encourage the students to work reasonable hours, take reasonable breaks, and rest on holidays. Discuss annual leave as a thing that is anticipated, and set positive expectations that students use annual leave. Model healthy behaviors. Well-rested students work far more productively.

## 9.4 Final thoughts

We recognize that many of the issues addressed here cannot be completely resolved by a single actor or institution. Issues of workforce development and diversity, equity and inclusion are very seldom simple to resolve, and the agencies, national and university labs and facilities, universities, and individual PIs all must play a role in addressing the identified challenges. In our science we recognize that larger problems must be broken down into smaller parts, which are resolved piece by piece, in order to address the end goal. In contrast, in issues of inclusion and equal opportunity we more often let the perfect be the enemy of the good and fail to take action until we can see that we have found the perfect path that we know will definitely fully achieve the final goal. However, if every actor and institution refuses to take action until it is clear that all other obstacles to progress will be simultaneously resolved, the situation will never change. Only when we as a community, our institutions, our national labs and the agencies all firmly decide to take positive, even if often imperfect or incomplete, steps forward, can we truly make progress towards offering equal opportunities for all to pursue a career in nuclear science. Only when such opportunities are equitably available to all in society can nuclear science reach its full potential and competitively address the exciting and challenging physics discussed in the new Long Range Plan.

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## A Survey distribution process

### A.1 Initial email

The following email was distributed to a representative faculty member at each institution which has nuclear physics funding in the USA on April 22, 2023.

Dear Colleagues:

Please share the email below with your CURRENT nuclear physics graduate students. It will help inform the Long Range Plan Workforce Development Subcommittee's recommendations. If there are any questions, please let me know.

Best wishes, Shelly

Dear Nuclear Physics Graduate Students,

We are reaching out to you to seek your input on the climate and working conditions for graduate students in the nuclear physics community. The Nuclear Science Advisory Committee (NSAC) is tasked approximately every seven years to advise the funding agencies, NSF and DOE, on their funding priorities in the form of a Long Range Plan (LRP). We received a charge from NSF and DOE to draft the next LRP in summer 2022 and are currently working on the Workforce Development part of the plan. We believe it important to hear from you about your experience of the nuclear physics community. We would want your voice to inform our graduate students recommendations to NSF and DOE.

We ask that you please take five to ten minutes of your time to complete the complete the anonymous survey here: <https://forms.gle/sYe5FvE3qM74x4hC8>

For optimal impact, please complete the survey by Wednesday May 3rd.

Please reach out should you have any questions or concerns.

Thank you for your assistance in shaping the recommendations of the Long Range Plan!

Best wishes,

Shelly Leshner

By April 24, two days later, already 43 responses to the survey had been received so it is clear that graduate students received this first message.

### A.2 Follow up communications

The following reminder email was sent out on May 16, 2023 to all of the Conference Experience for Under-graduates research mentors.

**Subject:** LRP - Graduate Survey- Please distribute

I am sorry if you have received this email more than once. As part of the Long Range Plan in Nuclear Physics we are requesting information from our graduate students. Could you please send this survey to the nuclear graduate students?

Thank you, Shelly

[https://docs.google.com/forms/d/e/1FAIpQLSc5\\_zCog1Plm12rQw-q0gqB-SFfiXFxJNg3NxPwco9SKi0qlw/viewform](https://docs.google.com/forms/d/e/1FAIpQLSc5_zCog1Plm12rQw-q0gqB-SFfiXFxJNg3NxPwco9SKi0qlw/viewform)

Additionally, the survey details were shared with the LRP writing committee for them to further disseminate on May 16.

Dear LRP Members:

Could you please send this survey to the nuclear graduate students? It's important for us to hear from them for the upcoming long-range plan in nuclear science.


Thank you, Shelly

[https://docs.google.com/forms/d/e/1FAIpQLSc5\\_zCog1Plm12rQw-q0gqB-SFfiXfxJNg3NxPwco9SKi0qlw/viewform](https://docs.google.com/forms/d/e/1FAIpQLSc5_zCog1Plm12rQw-q0gqB-SFfiXfxJNg3NxPwco9SKi0qlw/viewform)

## B Survey details and images

The survey was drafted and circulated in a google form, images of which are presented here in the order in which the questions appeared in the survey in Figures 14 to 18.


The preamble established the purpose of the survey and that it was fully anonymous. The first question was the only mandatory question in the survey to ensure that responses were only recorded from individuals engaged in relevant nuclear science graduate research (Figure 14). None of the other questions on the survey were mandatory. The first set of questions addressed how graduate students felt about their current situation. This was followed by a section designed to establish if they had been made to feel uncomfortable in any professional settings (Figure 15) due to their identity or status. Graduate students were then questioned about their experience of potential financial stressors. These questions were designed to address basic needs such as healthcare, housing, transportation, food and the ability to afford the necessary tools and travel to fulfil their research responsibilities (Figure 16). In order to help interpret the financial questions in context, the graduate students were then asked about the size of their household (Figure 17). There followed a series of questions as to whether the graduate student had taken on work external to their responsibilities as a graduate student at their home institution and, if so, for how many hours per week. They were then asked if there was anything else they would like to share with the LRP committee (Figure 17). Finally, in line with best practices, participants were asked personal information at the end of the survey including demographic characteristics: race, ethnicity, gender, and LGBTQ+ issues. To leave these questions as un-prescriptive as possible, these fields were left open and the data entered had to be hand-coded and classified to facilitate later analysis (Figure 18).




## NSAC LRP Graduate Student Feedback Form

We are working on the Workforce Development chapter of the new NSAC Long Range Plan (<https://science.osti.gov/np/nsac>) and felt it very important to learn directly from the graduate students about your experience as a nuclear physicist and how we can better support and include graduate students in the broader nuclear physics community. **Your response is fully anonymous** and we only ask general details about you and your location so we can better understand the data. **Data received will not be shared in a way that could potentially identify an institution or individual.** The more people complete the survey and the more candid those individuals are, the better our understanding will be of how to improve the support of the graduate students in our community. The data you share will enable us to advise NSF and DOE in the best ways we can target graduate student support. Thank you for assisting in this endeavor!

Anticipated time to complete: 5 - 10 minutes.

edownie@email.gwu.edu [Switch account](#) 

 Not shared

\* Indicates required question

Please select which best describes your research. \*

- ☐ Nuclear Physics Experiment
- ☐ Nuclear Physics Theory
- ☐ Nuclear Physics Other
- ☐ Other: \_\_\_\_\_

Figure 14: Survey preamble and research field question.

Since you began graduate school, please rate the following statements about how you feel as an individual.

|  | Yes, frequently       | Yes, sometimes        | No                    | Not Applicable        |
|--|-----------------------|-----------------------|-----------------------|-----------------------|
| I feel I belong and am supported in my department  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I struggle to fulfill my research responsibilities | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I experience anxiety and / or depression           | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I am concerned about my future                     | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I am responsible for caring for a family member    | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I feel supported by my advisor / mentor            | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Since you began graduate school, have you been made to feel uncomfortable due to your gender, race, sexuality, religion, socioeconomic status, or other aspects of your identity or status, in the following settings?

|  | Yes, frequently       | Yes, sometimes        | No                    | Not Applicable        |
|--|-----------------------|-----------------------|-----------------------|-----------------------|
| In your research group                               | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| In your classes                                      | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| In your department                                   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| In another professional setting such as a conference | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Figure 15: Survey questions on respondent situation, outlook and mental health status.

Since you began graduate school, please rate the following statements about your financial wellbeing.

|   | Yes, frequently       | Yes, sometimes        | No                    | Not Applicable        |
|---|-----------------------|-----------------------|-----------------------|-----------------------|
| I have trouble paying for food  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I have trouble paying for housing   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I have trouble paying for utilities / other regular costs   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I have struggled to afford healthcare   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I have had trouble affording or arranging reasonable transportation to my place of research / study   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I have had trouble paying for or arranging transportation to fulfil other basic or social needs, such as going to the doctor or supermarket or meeting with friends | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I have unreliable internet access   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I have struggled to afford the tools or travel I need in order to complete my academic / research responsibilities  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Figure 16: Survey questions on financial well-being.

Do you have an unreliable computer to do coursework / research?

☐ Yes

☐ No

☐ N/A

How many people are there in your household (including those you live with in a mutually supportive manner such as your partner or family, not those who are simply your room mates)?

Your answer \_\_\_\_\_

Have you had to take on additional employment in addition to your graduate degree work in order to support yourself adequately, such as tutoring, food service etc.?

**Please remember that the form is completely anonymous - we cannot identify you** and the more candid you are, the more accurately we can target the resolutions to support graduate students.

☐ Yes

☐ Sometimes

☐ No

If you have had to take on extra work, how many hours per week (on average) have you had to work while you were working?

Your answer \_\_\_\_\_

Is there anything else you would like the committee to think about or consider in the Workforce Development section of the NSAC Long Range Plan?

Your answer \_\_\_\_\_

Figure 17: Survey questions on household size and external employment.

### Understanding The Nuclear Physics Community

We recognize that physicists with less well-represented identities or backgrounds may face larger barriers to full participation and inclusion in the nuclear physics community. We also recognize that the cost of living and other stressors can be strongly correlated to the type of environment in which colleges are found. We are trying to understand which of the answers above are most correlated in order to better target interventions to improve the community support of graduate students. To that end it would be very helpful if you were prepared to answer the following questions. We will treat the information confidentially and it will only be reported out in aggregate in the Long Range Plan. ***As a reminder, the survey is completely anonymous and we cannot identify any individual from their responses.***

Please share your gender.

Your answer \_\_\_\_\_

Please share your race and ethnicity.

Your answer \_\_\_\_\_

Do you identify as a member of the LGBTQ+ community?

- ☐ Yes
- ☐ No
- ☐ Would prefer not to say

Please select the description that best matches your college's location.

- ☐ Major metropolitan area (e.g. Chicago, New York, Boston, L.A)
- ☐ Urban area (e.g. Knoxville, Columbus, Minneapolis)
- ☐ College town (e.g. Bloomington, Athens, Urbana Champaign, Ithaca)
- ☐ Other: \_\_\_\_\_

Figure 18: Survey questions on institution location and respondent demographics.