EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

ALICE-PUBLIC-2025-001
CMS NOTE-2025/001
January 28, 2025

Assessing the mental health state of LHC scientists

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Abstract

A series of mental health awareness trainings have been initiated by the Early Career Scientists Fora (ECSF) to support and inform the LHC community. Building on a series of workshops, held online and in person at CERN between 2021 and 2023, a survey was shared with all four major experiments to assess the mental health perceptions and needs of participants. In this note the main survey findings are presented, with specific attention to the role work culture, career uncertainty, and support networks play in this scientific community. We hope this work raises awareness around the experience of mental health in a large international scientific collaboration and offer evidence that can foster deeper understanding and broaden the scope for impactful interventions.

Keywords: ALICE, CMS, LHCb, ATLAS, Mental health workshops

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1 Introduction

The focus on mental health has risen internationally, coming to the forefront of policy makers' and institutions' priorities [1], especially since the COVID-19 pandemic. The World Health Organisation considers mental health a basic human right and defines it as a state of wellbeing, in which every individual realises their own potential, can cope with the normal stresses of life, work productively and fruitfully, and is able to make a contribution to their community. Around the world there are many ongoing endeavors to find ways to face the increasing mental health challenges within academic communities [2, 3, 4, 5, 6]. Specifically, there is growing evidence of the need to support PhD students' and Early Career Researchers' (ECRs) mental health [7, 8, 9, 10, 11, 12] as part of an international effort in creating tools to support students and staff in higher education [13, 14, 15].

Within CERN, the LHC Early Career Scientists Fora (ECSF) and the LHCb Collaboration have published reports [16, 17, 18] addressing the impact the COVID-19 pandemic had on their scientific community. A survey conducted in 2020 [18] highlighted a decrease in mental health especially within the younger section of the community with a consequent decline in productivity and motivation. Furthermore, a publication [19] on behalf of the ECFA ECR Panel [20] (majorly represented by members of the LHC communities), highlighted the lack of networking opportunities, missing recognition, and diversity-related issues. Promoting mental health in higher education settings mostly involves the creation of structural frameworks or individual interventions [21]. The latter has been the preferred course of action within the LHC scientific community which has organised initiatives centered on stress management, soft skills, communication, and mental health awareness [22]. Focusing on improving skills and knowledge to foster mental health has proven to be an effective method of intervention applied in higher education settings [23, 24]. Furthermore, there is good evidence that faculty and staff play a key role in improving the general wellbeing of an academic community, which is understood as a synergistic ecosystem [25, 26, 27].

Between 2021 and 2023, a series of mental health awareness workshops entitled *Healthy Minds for Masterminds* were organised by the LHC ECSF [17] at CERN and held by psychologist and life coach Sarah Speziali [28]. As a follow-up, a survey was conducted among the four major LHC experiments (ALICE, ATLAS, CMS, and LHCb) to gauge the researchers' mental health experiences and awareness. This note presents key findings from the survey focusing on the role that external factors, such as the working environment, have on an individuals' mental health. We hope to shed light on potential areas where further coordinated mental health interventions can support LHC's scientific community to thrive.

2 Methodology and dataset

The survey was developed by the *ALICE Junior Representatives* [29] in collaboration with Sarah Speziali and is supported by the *ALICE Diversity Office* [30]. It was created taking inspiration from validated mental health tools, such as the General Health Questionnaire (GHQ-12) [31], the Depression Anxiety Stress Scale (DASS-21) [32], the Generalised Anxiety Disorder Assessment (GAD-7) [33], and the Patient Health Questionnaire (PHQ-9) [34]. The survey was composed of 32 questions, grouped into 5 sections, dealing with general information about the participants and their work place details, mental health experiences, working environment, and personal mental health state. Out of all questions, 6 were optional and for some of them the respondents had the opportunity to submit longer comments. The questions were implemented in a *Google Form* [35] and conducted as an anonymous questionnaire.

All ALICE Collaboration members were invited to submit a reply to the survey via the *alice-member* mailing list at the beginning of May 2023. At the same time, the survey was advertised within the LHCb Collaboration via the *lhcb-early-career* mailing list, which contains all LHCb members without a permanent position (mostly early career scientists). At the beginning of June, the survey was sent out to all CMS Collaboration members via the *cms-members* mailing list. During an ATLAS Collaboration Week

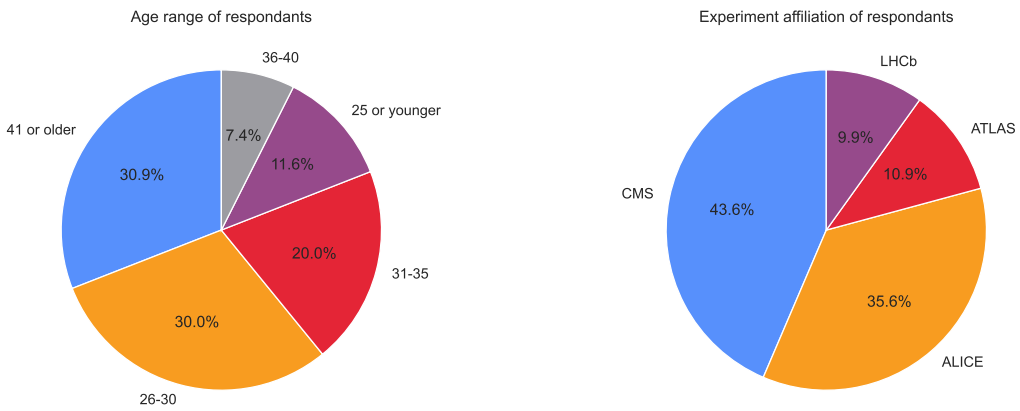

Fig. 1: Age profile (left) and experiment affiliation (right) of all respondents (N = 404).

at the end of June 2023, the initiative was advertised to all ATLAS members by the *ATLAS Diversity and Inclusion Office* [36].

In the scope of the LHCP 2023 conference outreach talk *Experiences from Mental Health Workshops for LHC Scientists* [16], preliminary results from the survey were reported as a part of the evaluation of the effects of the *Healthy Minds for Masterminds* mental health awareness workshops for LHC scientists. Since, at that time, CMS and ATLAS scientists were poorly represented in the replies and upon strong positive feedback regarding the survey, more responses were gathered until the end of June 2023. In total, 404 scientists representing ≈7% of all ALICE, ≈1% of all ATLAS, ≈3% of all CMS collaborators and ≈7% of the LHCb early career scientists responded to the survey. Figure 1 shows the age profile and experiment affiliation of all respondents to the survey. With 41.6% of the respondents being 30 or younger and 30.9% being 41 or older, both senior and early career researchers are represented in the survey results. In this figure and all following ones, $N = X$ denotes the total number of replies to the question presented in the figure. Figure 2 presents the number of replies per experiment normalised by the total number of collaborators for ALICE, ATLAS, and CMS. In the case of LHCb, the number of replies is normalised by the total number of LHCb members without a permanent position, since the survey was only distributed among that group as described above.

Since the replies to the survey were collected on a voluntary basis, we are aware of the fact that the results might be biased in several ways as described in the following. The survey was distributed by the ECSF representatives of each collaboration within their communities. Although the questionnaire was targeted towards scientists of all career levels, the decision about the means of distributing was left with the collaborations' ECSF representatives. Consequently, it has to be noted that in case of the LHCb Collaboration only the young researcher community is represented in the results. Besides that, collaborators who filled in the survey may have already gained a certain level of awareness about mental health related topics. Combined with the limited attendance, the obtained results might therefore not be fully representative for the communities of the four major LHC experiments as a whole. Furthermore, it must be acknowledged that the number of replies is not equally distributed across the four collaborations mainly due to their differing sizes and varying number of responses from their respective communities. Although the collected data sample is statistically limited, the results clearly show that a significant number of the participants regularly encounter (or have encountered) mental health challenges (as described in section 3) that are likely to have a negative impact on their quality of life and their working capabilities. We therefore think it should be treated as a valuable resource for assessing the mental health state of LHC scientists.

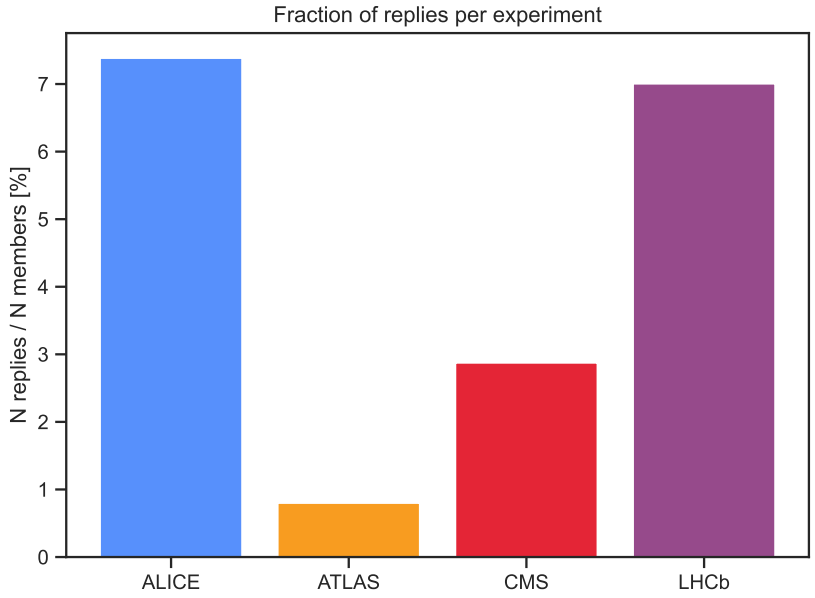

Fig. 2: Number of respondents per experiment normalised by the experiment's total number of collaborators in case of ALICE, ATLAS, and CMS. Number of respondents per experiment normalised by the total number of LHCb members without a permanent position in case of LHCb.

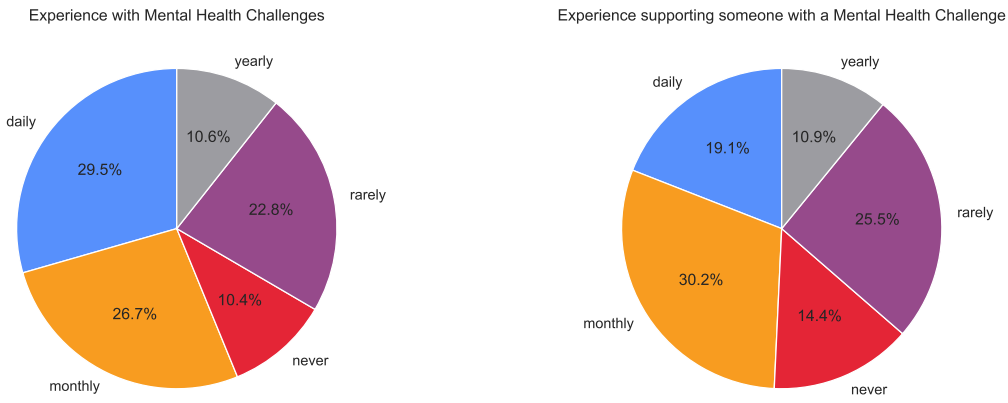

Fig. 3: How often participants experienced mental health challenges (left) and how often they supported someone else facing such challenges (right) (N = 404).

3 Key findings

In this section the key results of the survey are presented focusing on findings which help to assess the mental health state of the participants. Particular attention is placed on how these are connected to their working environment and other external factors closely related to the work in academia and specifically in large collaborations.

3.1 Mental health experience and challenges

To gauge the general level of knowledge about the topic, participants were asked to state how often they experience mental health challenges themselves or support someone else with a mental health challenge (see Figure 3). Out of 404 respondents, 56.2% are facing mental health challenges on a daily or monthly

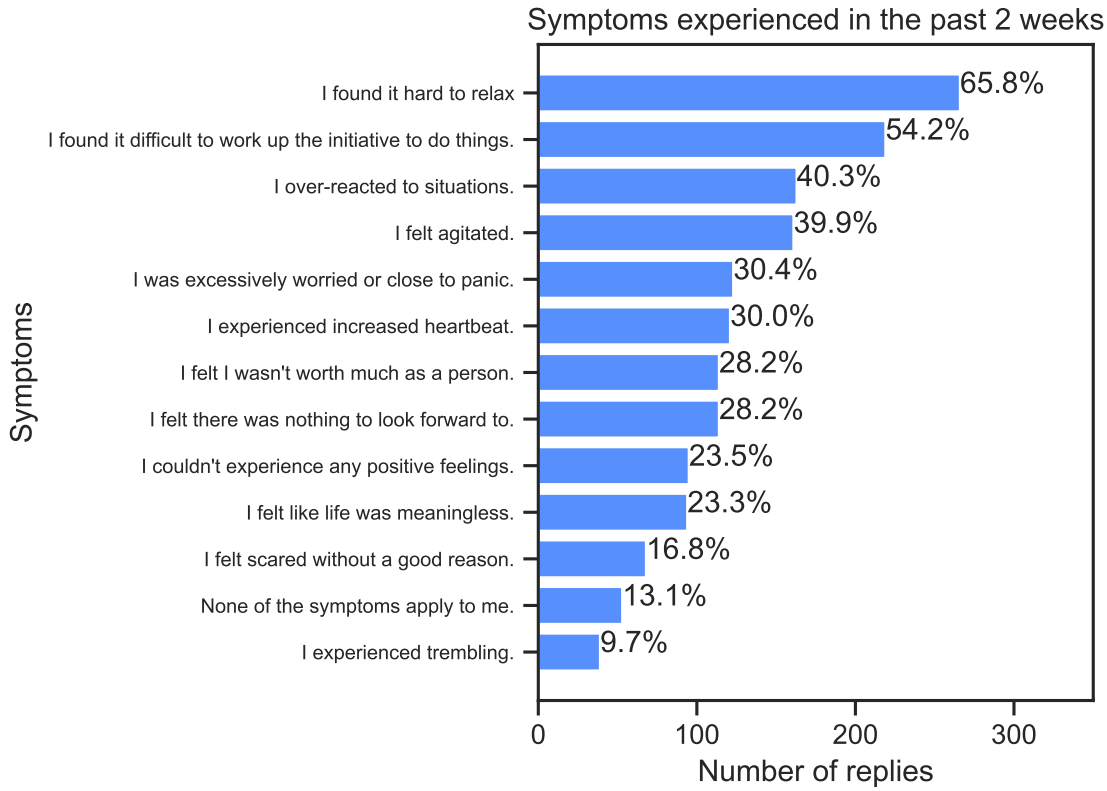

Fig. 4: List of symptoms experienced by the respondents (N = 404) in the two weeks prior to the survey. Multiple answers were possible.

basis, while only 10.4% indicated that they have not experienced any mental health challenge so far. When correlating this information with the age range of the respondents, it becomes clear that the majority (74.9%) of the participants regularly facing mental health challenges is made up by young researchers who are 35 years old or younger. The fraction of respondents who have never experienced any mental health challenges, on the other hand, is dominated by scientists who are older than 35 years (66.7%). In addition, it was found that 49.3% of all participants are experienced with supporting someone struggling with mental health challenges, as shown by the replies *daily* and *monthly* in the chart on the right hand side of Figure 3. A significant overlap was observed between them and the participants experiencing mental health challenges on a daily or monthly basis themselves. The stated numbers show that the topic of mental health is clearly prevalent among the responding scientists.

In a second step, the participants were asked to indicate which of the symptoms listed in Figure 4 they could observe on themselves in the two weeks prior to completing the survey, with the possibility of selecting multiple choices. The time period of two weeks was chosen since it is commonly used in mental health practice to assess mental health states, reducing biases due to fluctuations in mood or other factors influencing the short-term state of mind [33, 34]. A majority of the respondents found it hard to relax (65.8%) and lacked the motivation to initiate things (54.2%). More than a third of the survey participants over-reacted to situations or felt agitated and worried or were even close to panic. More severe symptoms like increased heartbeat (30.0%), not feeling worth much as a person (28.2%), feeling like life was meaningless (23.3%) or having nothing to look forward to (28.2%) were observed for more than 94 respondents. This striking result can be directly connected to the need for more clinical mental health support and education to increase awareness and strengthen psychological coping skills.

The result presented in Figure 4 can be compared to the scientists' self-assessment of experiencing mental

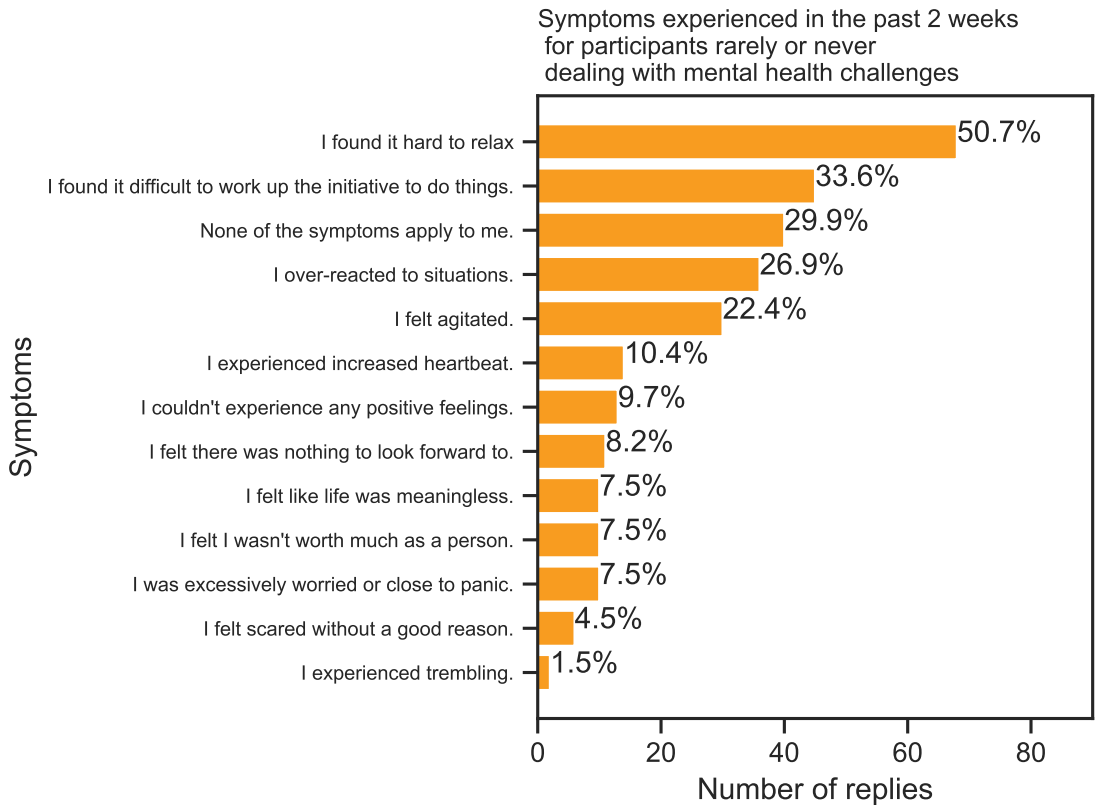

Fig. 5: List of symptoms experienced in the two weeks prior to the survey by respondents who only rarely or never experience mental health challenges (N = 134). Multiple answers were possible.

health challenges shown previously in Figure 3. While only 13.0% of the replying scientists indicated that none of the mentioned symptoms applied to them in the previous two weeks (compare Figure 4), 33.2% stated that they never or only rarely experience challenges related to their mental health (compare right panel of Figure 3). Figure 5 shows the subset of the results presented in Figure 4, corresponding to the respondents who never or rarely experience mental health challenges. Only 29.9% of them declared that they did not experience any of the listed symptoms in the previous two weeks while 50.7% found it hard to relax and over a third found it difficult to work up the initiative to do things. The result indicates an inconsistency in the participants' self-assessment of their mental health state potentially rooted in the lack of in-depth knowledge of the topic. As a result, signs of poor mental health may not be recognised as such. Consequently, we suggest that the general knowledge and mental health awareness have to be increased and strengthened in the LHC community. We believe that a deeper level of the community members' awareness on the topic will foster asking for and accepting support as well as developing positive coping mechanisms.

3.2 Stress and work-life balance

The blue bars in Figure 6 show the number of working hours per week of all replying scientists in the month prior to the survey. Nearly 70% of the respondents indicated to have worked more than 40 hours per week, of which 46.4% worked between 41 and 50 hours and 22% more than 50 hours per week. In general, 62.6% of the participants replied that most of their colleagues work beyond their official working hours. A differential analysis of early career scientists' and the senior scientists' working hours, represented by the orange and red bars in Figure 6, respectively, shows that LHC scientists of all ages work a lot. No strong connection between the number of hours worked per week and the age range was

Fig. 6: Number of working hours per week of all participants (N = 404) (blue bars), participants who are 35 years or younger (N = 249) (orange bars), and respondents who are older than 35 years (N = 155) (red bars).

found. It has to be noted that the question regarding the number of working hours was left open for interpretation by the respondents. Students may have included their time for studying in the indicated working hours or rather only have taken into account research work within the collaboration. Similarly, research work for other collaborations or administrative work by senior colleagues might not have entered the statistics for all replying scientists. Furthermore, a more detailed analysis of the respondents who work fewer than 25 hours per week (5.7%) did not show any specific dependence on the age range. The average number of weekly working hours in the EU in 2022 [37] is considered for comparison. 51.8% of the employed people in the EU had an average working week of 40 to 49 hours, which is a slightly larger portion than what was found in this study for LHC scientists. However, only 7.6% of the employed people in the EU worked on average 50 hours or more per week compared to 22%, in the case of the responding LHC scientists. The trend of working long hours is no novelty in the academic field. A 2017 Nature article [38] highlights how 38% of early-career researchers worldwide reported working more than 60 hours each week, 9% of whom claimed to work more than 80 hours. Senior academics in Germany reported working an average of 52 hours per week [39] and university lecturers and professors in the UK University and College Union (UCU) reported that 41% of employees with full-time contracts said that they worked more than 50 hours a week and felt pressured to work long hours. The complexity of work demands on early-career scientists is well documented in literature, with a keen focus on the link between occupational stress and long working hours [40]. The 2022 Nature Graduate Survey [41] found that 43.1% of PhD students were working on average 50 hours per week or more. Furthermore, around 40% were not or not at all satisfied with their working hours and almost half mentioned their work-life balance as part of the top three most challenging issues when conducting PhD research [42].

As seen in Figure 7, the majority of the survey participants (78.5%) indicated study and work as their main stress triggers, followed by life events (38.1%), relationships (36.4%), environment (26.7%), and change (21.0%). There are various definitions of stress available in literature. In the context of this note, we refer to the Mental Health Foundation's description [43], defining stress as our body's response to pressures from a situation or life event. Understanding that what contributes to feeling and dealing with stress can vary hugely from person to person and differs according to our social and economic circumstances, the environment we live in, and our genetic makeup. Bearing in mind that some common

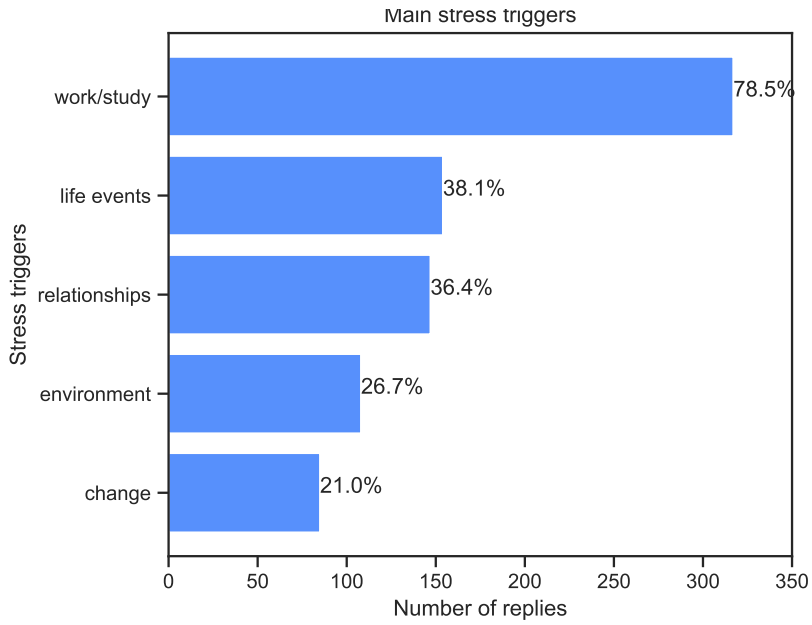

Fig. 7: Main stress triggers of all replying scientists (N = 404).

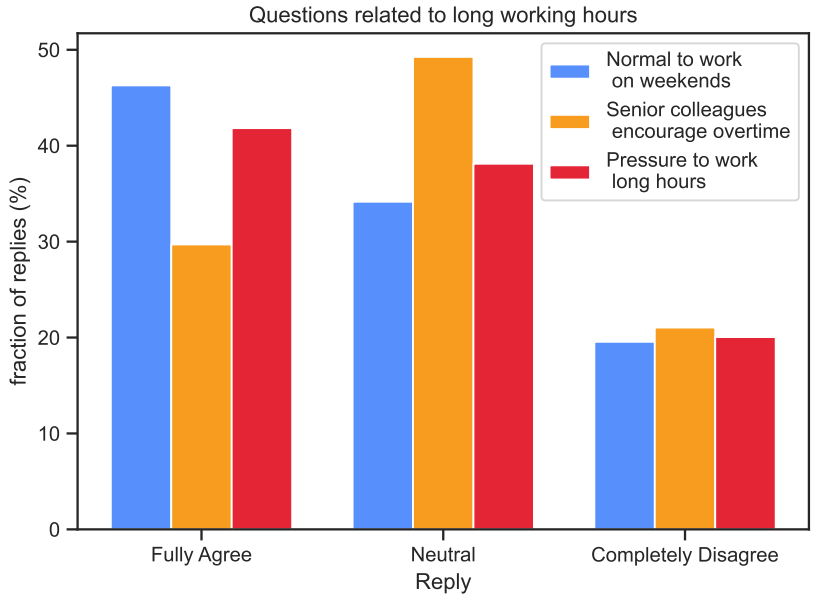

Fig. 8: Participants' responses to questions related to long working hours (N = 404).

stress triggers include experiencing something new or unexpected that threatens our feeling of self or the sense of having little control over a situation. When encountering stress, our body produces stress hormones that trigger a fight-or-flight response and activate our immune system. Too much stress can cause adverse effects leaving us feeling overwhelmed or unable to cope. In the long term, this can affect our physical and mental health leading to feeling anxious, sad, irritable as well as experiencing headaches, nausea, shallow breathing, and tension. These considerations justify the focus of this note: how, within the LHC community, mental health levels also linked to stress are connected to external factors such as long working hours, uncertain future career perspectives, and work interactions. Figure 8 shows that 29.7% of the respondents agree to the statement that senior colleagues encourage to work overtime, 46.3% think that it is considered normal to work on weekends, and 41.8% stated that they

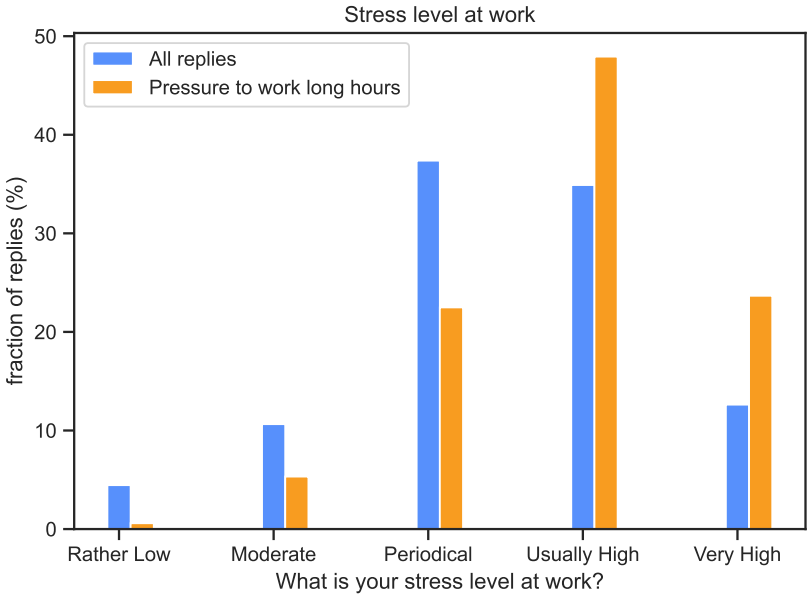

Fig. 9: Stress level of all replying scientists (N = 404) (blue bars) and respondents who fully agreed to the statement that they feel pressured to work long hours (N = 169) (orange bars).

indeed feel pressured to work long hours. These results indicate that the generally demanding workload of scientists in the LHC community is paired with external pressure factors. A differential assessment of the participants' stress level at work showed that nearly half of them (47.5%) experience very high or usually high levels of stress as shown by the blue bars in Figure 9. When correlating this to the external pressure to work long hours (orange bars in Figure 9), it becomes clear that the feeling of being pressured indeed leads to generally higher stress levels.

To examine the effect of long working hours, external pressure, and high stress levels, the correlation between the survey participants' work-life balance and the presented results was investigated. Figure 10 presents the participants' level of agreement to the statement *It is hard to find and maintain a work-life balance*. While the blue bars in Figure 10 show the result for all replying scientists, the orange and red bars reflect the results of respondents with very high or usually high stress levels at work and a strong feeling of being under pressure, respectively. It becomes clear that scientists with higher stress levels on average find it harder to maintain a work-life balance. Similarly, a higher pressure to work long hours is connected to a poor work-life balance. In general, out of all survey participants a majority (60.1%) indicated that they find it hard to maintain a work-life balance, while only 8.7% do not.

Finally, from the survey it also emerged that nearly half of the participants often neglect tasks because they have too much work to carry out, as seen in the top panel of Figure 11, which can be interpreted as a decrease of their work quality. A correlation of the replies with the number of working hours per week, presented in the bottom panel of Figure 11, shows that the respondents who work longest have a stronger tendency to neglect tasks compared to those who work less.

3.3 Uncertainty and support network

As previously mentioned, the element of uncertainty regarding future personal and professional development is strongly connected to mental health and stress responses. This is shown in relation to one's personal future results in Figure 12. The figure reports the participants' level of agreement to the three statements: 1) *It is hard to plan my future career*; 2) *I am uncertain that I will achieve my career goals*; and 3) *I am confident about my future professional development*. The results are clearly showing that the high stress level at work or during studies is paired with a strong feeling of uncertainty about future

Fig. 10: Participants' level of agreement to the statement *It is hard to find and maintain a work-life balance*: All replying scientists (N = 404) (blue bars), respondents with very high or usually high stress level at work (N = 192) (blue bars), participants who feel pressured to work long hours (N = 169) (red bars).

professional development and career goals. 60.4% of the respondents find it hard to plan their future career, 49% are uncertain that they will achieve their career goals and only 23% are confident about their future professional development.

Another important aspect to be considered is the role of a strong support network, which is proven to have a positive impact on mental health [44, 45]. In the survey, it was found that a large fraction of the participants (39.9%) indicated that they feel they are not living close enough to their support network. Especially among early career researcher this is a shared experience. 50.2% of the participants who are 35 years old or younger share that feeling, highlighting the importance of building support networks in the place where one lives, for example among colleagues. An assessment of the level of support by supervisors and peers, presented in Figure 13, shows that a large fraction of the respondents are feeling motivated by their supervisor, who help them to achieve their goals and to find solutions to their problems. Most of the participants reported being treated fairly by their supervisors and indicated that their supervisor cares about their needs. These results show that generally the support from peers and supervisors is strong in the LHC community. The authors believe this to be a key element that can be further developed and strengthened.

4 Summary and conclusion

In this note, the key findings of a mental health survey distributed among the four major LHC experiments were presented. Generally, it was found that the topic of mental health is prevalent among LHC scientists. A large fraction of the survey respondents have regular experience with mental health challenges and supporting someone with their mental health. Symptoms related to poor mental health, which were reported by the participants, range from mild to very severe, such as increased heartbeat or feeling life is meaningless. From the survey results it also emerged that signs of poor mental health are not always recognised as such, which emphasises the need for more mental health initiatives that can raise awareness and foster psychological resilience.

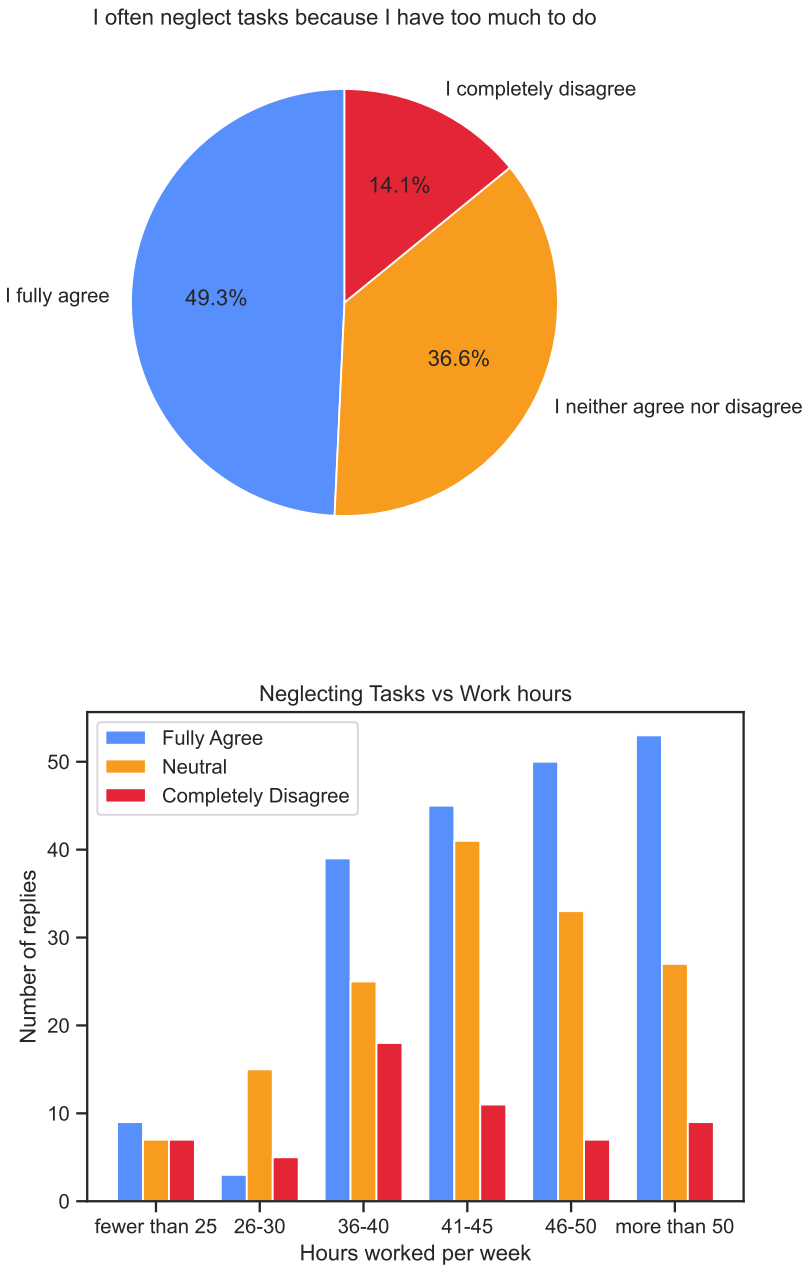

Fig. 11: Participants' level of agreement to the statement *I often neglect tasks because I have too much to do*: All replying scientists (top), differential in number of participants' working hours per week (bottom) (N = 404).

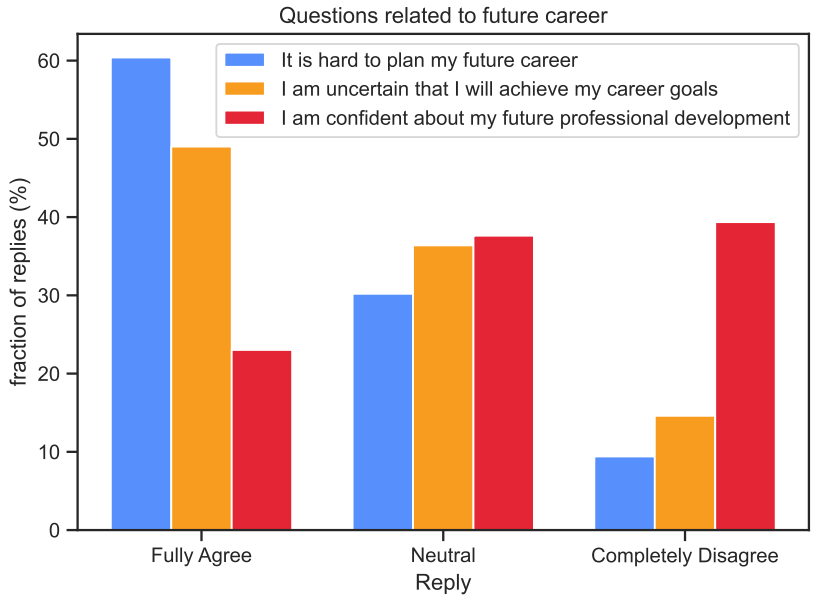

Fig. 12: Participants' level of agreement to the statements *It is hard to plan my future career* (blue bars), *I am uncertain that I will achieve my career goals* (orange bars), and *I am confident about my future professional development* (red bars) (N = 404).

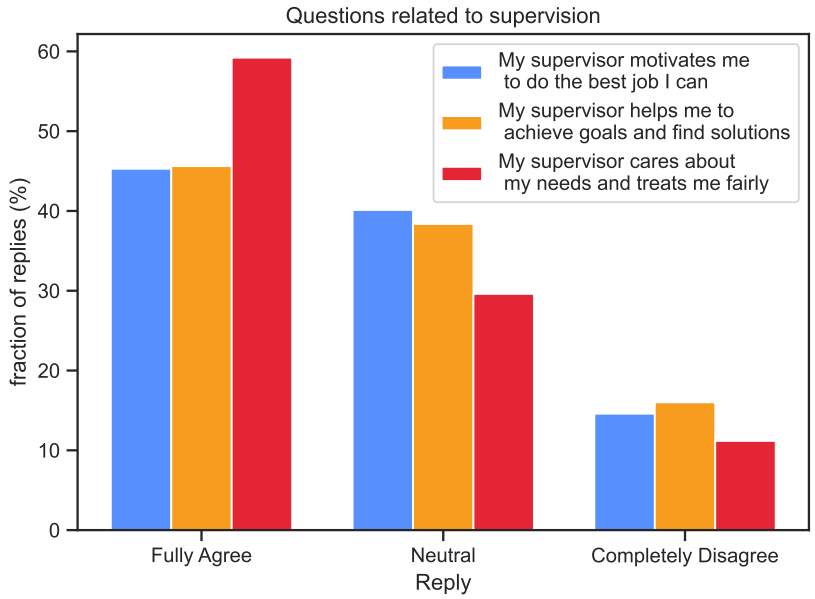

Fig. 13: Participants' level of agreement to the statements *My supervisor motivates me to do the best job I can* (N = 329) (blue bars), *My supervisor helps me to achieve goals and find solutions to my problems* (N = 331) (orange bars), and *My supervisor cares about my needs and treats me fairly* (N = 331) (red bars).

Furthermore, it was found that the generally high and demanding workload of LHC scientists is paired with external pressure, which leads to increased stress levels at work. A poor work-life balance and the tendency to neglect tasks are direct consequences of the high stress environment and they can lead to a decrease in work quality.

An additional factor is the strong feeling of uncertainty regarding the future professional development and career goals, which was observed in a large fraction of the responding scientists. The fact that many researchers are not living close enough to their support network enhances this sense of uncertainty. The support by supervisors was found to be strong in the LHC community. We think that the positive role that supervisors play is something that can be built upon.

With these results the need for a larger data sample clearly emerges in order to learn to what extent the observed fractions are representative, and to better estimate the true extent of mental health challenges in the LHC community. To allow for a more representative and differential study, a potential broader follow-up survey is planned by the authors. In view of the limitations of the presented survey described in section 2, a number of improvements should be considered for the following questionnaire. For a more differential study regarding age levels and different life situations, information about the career level of the collaborators has to be included. Moreover, the timing and means of advertising the survey should be optimised and aligned among the four collaborations.

We hope that the current findings may offer a stimulating starting point to envision potential future mental health initiatives and harness current good practices within LHC [22] to allow for the community's mental health to flourish. By making these partly striking results public, we hope to enhance the interest in the topic of mental health and to help increase awareness within the LHC community.

Getting help

Are you struggling with your mental health?

Resources for CERN scientists:

- https://hse.cern/content/mental-health-support
- https://home.cern/news/news/cern/cerns-mental-health-resources

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