PROCEEDINGS OF SCIENCE

The Early Career Researchers' Input to the 2026 Update of the European Strategy for Particle Physics

Alexander Burgman[a,*] **and Abdelhamid Haddad**[b,*]

[a] *Department of Physics, Stockholm University, 106 91, Stockholm, Sweden*

[b] *Université Clermont-Auvergne, Laboratoire de Physique de Clermont Auvergne, CNRS/IN2P3, 4 Av. Blaise Pascal, 63178, Aubière Cedex, France*

E-mail: alexander.burgman@fysik.su.se, abdelhamid.haddad@cern.ch

The future of particle physics depends on today's early career researchers (ECRs), yet many face challenges in their career development, well-being and mental health, inclusivity, and often limited recognition. All of these factors and many more threaten dangerously the long-term stability and future of the field. To identify, highlight, and address these issues, a community-wide ECR initiative was launched with the support of the ECFA ECR Panel. Further supported by a survey of 936 participants, this effort resulted in a 100-page white paper with 55 recommendations and a formal input to the 2026 European Strategy for Particle Physics Update. The effort seeks to build a sustainable, inclusive, and supportive environment for the next generation of particle physicists.

The European Physical Society Conference on High Energy Physics (EPS-HEP2025)
7-11 July 2025
Marseille, France

[*] Speakers

PoS(EPS-HEP2025)608

1. Introduction

The European Strategy for Particle Physics (ESPP) process defines the near- to long-term future of the field in Europe. At the top of the decision-making process stands the CERN Council, which, after consulting the particle physics community at large, defines the long-term strategy for European particle physics. Ahead of the 2026 ESPP Update (ESPPU), which aims to identify the next flagship project at CERN, the European Early Career Researchers[1] (ECRs) community launched an open, self-organised initiative, formally endorsed by the ECR Panel of the European Committee for Future Accelerators (ECFA ECR) [1]. The aim was to provide input to the ESPPU focusing on aspects particularly relevant to ECRs. The task-force started at the 3rd ECFA workshop in Paris [2], where all members of the ECR community were invited to join. The work was organised into five dedicated working groups:

- Career prospects and ECR leadership
- Diversity, inclusion, and mental health
- Communicating the importance of particle physics
- Future colliders
- Future experiments beyond colliders

The groups met regularly and kept the wider community involved through workshops [3, 4], along with a community-wide survey that gathered responses from 936 participants, of which 799 were European ECRs considered in the plots. These were well distributed across academic levels, fields of work, and experiments, as shown in Fig. 1. The outcome was a 100-page white paper [5], acknowledging the efforts already made while highlighting the key challenges faced by ECRs. The document motivates 55 recommendations as suggestions for improvement, widely presented in [6], and the executive summary was submitted as input to the ESPPU [7] and later discussed at the ESPPU Open Symposium in Venice [8]. To date, this effort has received support from 149 individuals [9].

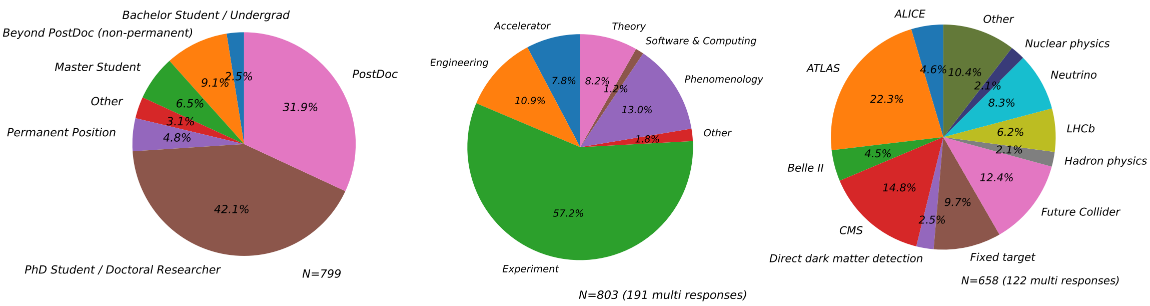

Figure 1: Distribution of survey respondents by academic status (left), field (middle) and experiment (right).

[1] Studying in or employed at European institutes, with non-permanent positions or less than 10 years after the PhD.

PoS(EPS-HEP2025)608

2. Career prospects

Among the many aspects of ECRs' lives, career-related issues play a central role in their well-being. This was already manifest from the 2022 ECFA ECR Panel survey [10], conducted prior to this work. As Fig. 2 shows, at the top of the measures that ECRs feel are necessary to improve their personal situation stands the academic job market. Currently, ECRs are often required to take multiple back-to-back short-term underpaid contracts with no guarantee of a permanent position. This comes with significant pressure to complete projects within a short timescale, discouraging them from pursuing their own, potentially more ambitious, research topics. These contracts are often located in different cities or countries, adding further stress and posing a major challenge for family life and long-term social connections. The situation would be significantly improved by promoting postdoc contracts of at least 3 years and by making a more structured path to permanent positions.

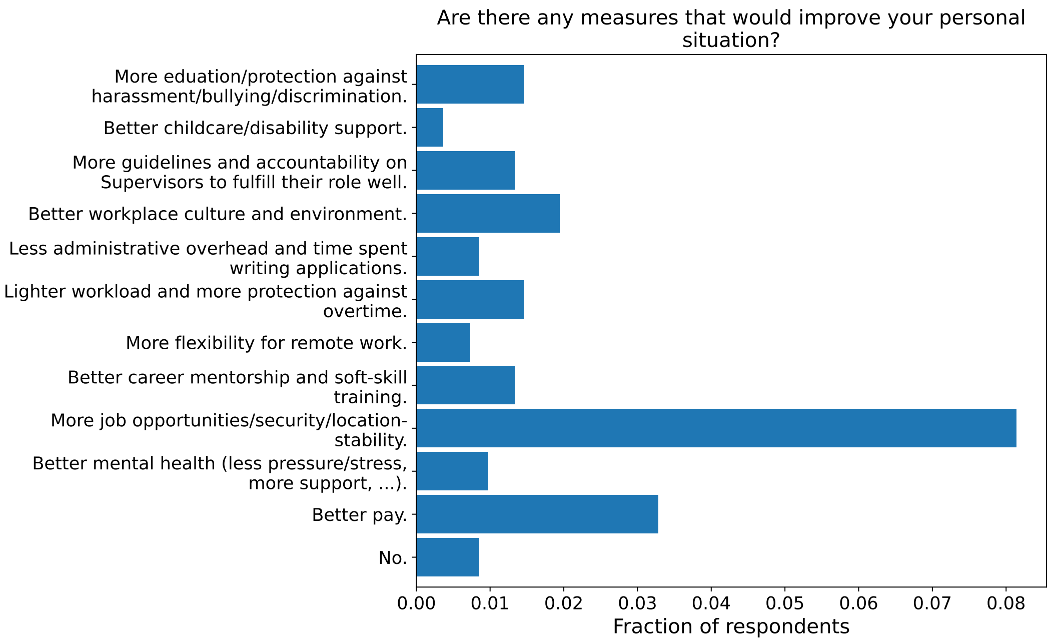

Figure 2: Categories of measures that respondents indicated would improve their personal situations. Fractions are based on all 759 respondents to this question; empty responses are omitted. Figure from [10].

Another aspect is the lack of recognition for secondary and non-research contributions in institutional benchmarks, often referred to, sometimes pejoratively, as "soft skills". ECRs emphasised the need for training in transferable skills relevant to both academia and industry, supported by effective career mentorship. Other common concerns include the need for mandatory supervision training to help staff align expectations and better understand supervisees' needs. Our survey shows that 80 % of respondents support such training, yet 59 % report that no program currently exists at their institutions. As a result of these concerns, many ECRs feel they are at a crossroads, weighing their passion for research against the reality of an unstable career. This risks losing highly motivated and skilled researchers and threatens the long-term sustainability and vitality of the field.

3. Wellbeing of ECRs & Diversity, Equity, and Inclusion

A fulfilling research career requires balancing the demands of professional work with personal life. When this balance is disrupted, it can negatively impact productivity, mental health, and even influence career choices. Alarmingly, our survey found that 57 % of respondents reported struggling with their mental health to some degree, and 80 % of those individuals had experienced discrimination or harassment. Thus, providing easy access to mental health services is vital for the community at large, particularly for ECRs, who are often in a more vulnerable position.

Additionally, as supported in [11], addressing diversity and sociological dimensions is crucial to ensure that the particle physics community remains inclusive, equitable, and representative of all its members. ECRs recognise CERN's commitment to diversity, equity, and inclusion (DEI) policies that enrich the working environment, and strongly support and encourage institutions and labs to establish dedicated DEI offices with appropriate resources. Key measures include enforcing zero tolerance for harassment and discrimination through accessible and anonymous reporting systems, providing mandatory DEI training and safe spaces, ensuring diversity in hiring panels and leadership roles, and maintaining publicly accessible codes of conduct. These efforts aim to foster a more inclusive, supportive, and equitable research environment across the field.

4. Community building and leadership

ECRs of today are the research leaders of tomorrow, and they are among the first to be affected by the decisions made today, particularly those related to the long-term plans at the core of the current ESPPU. However, as shown in Fig. 3, only 20 % of respondents feel that their opinions are heard in the process, while 30 % report that their decision to pursue a future in academia is influenced by the ESPPU. In the context of the ESPPU, the Physics Preparatory Group (PPG) is responsible for preparing the scientific contribution to the work of the European Strategy Group (ESG), based on input gathered from the community. Each PPG working group includes an ECR serving as a scientific secretary. However, the selection process for these positions is not fully transparent to the community, and their roles and responsibilities are not clearly defined.

Similarly, a transparent and democratic selection of ECFA ECR Panel representatives is essential to ensure bottom-up legitimacy and reflect the community's core democratic values. The ECFA ECR Panel should also be formally mandated to send an ECR delegate to the ESG. Furthermore, dedicated funding should be provided to support events and activities that strengthen the community's professional development. Overall, ECRs need a stronger voice in strategic roles and leadership. Keeping them engaged requires that they feel welcome and heard within the community. Including ECRs in executive boards and topical working groups would be a meaningful step toward a more inclusive environment.

5. Communication and Outreach

While conducting research in particle physics is challenging and requires mastering many complex skills and concepts, its significance is often unclear to the general public. Effective outreach is therefore essential, not only to strengthen public trust in science and counter misinformation, but

PoS(EPS-HEP2025)608

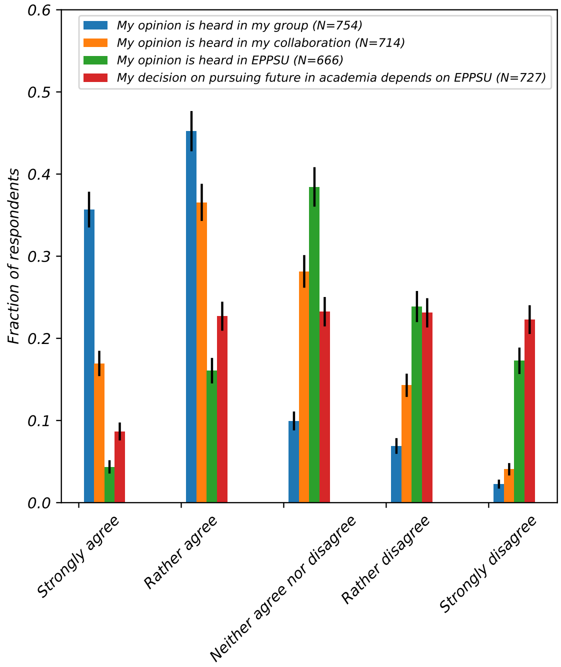

Figure 3: Fraction of responses on how ECRs feel their opinions are heard (at research group, collaboration, and ESPPU levels), and on whether the ESPPU outcome affects their career decisions. Figure from [5].

also to inspire future generations of scientists. According to our survey, 60 % of ECRs are already active in outreach, but 40 % feel their efforts are not adequately recognised and are undervalued in institutional benchmarks. Moreover, 40 % of ECRs do not feel sufficiently trained in science communication, highlighting the need for standardised training, adequate resources, and dedicated funding to support these activities. Several of our recommendations align with the ones in [12–14].

By engaging with society and highlighting the successes of particle physics, we can communicate transparently and effectively, building both public and political support for the next European flagship project. For instance, a large majority of ECRs (85 %) are motivated to engage with the public on topics related to future projects. However, we recommend orienting the storytelling to emphasise the role of future experiments as observatories rather than purely discovery machines, and to highlight the value of international collaboration.

6. Future Experiments

6.1 Future Flagship Collider

Out of the survey respondents, 80 % are in favour of building a future flagship collider. When considering which factors should drive the decision between different collider options, the main driving factors are seen as *technological innovation*, *physics baseline program*, and *collaboration*. Of medium importance for the decision between collider options are *sustainability*, and *smaller project support*, while of lower importance are *upgrade path*, *timeline*, *social acceptance*, and *location*. This does not indicate that the lower prioritised factors are low priority for ECRs, but only that they carry less importance in the decision between collider options. Of the survey respondents, 74 % report that the flagship collider should be built in the most sustainable way. Societal acceptance is also deemed important for any flagship option [5].

The respondents of the survey showed diversity in their preferred option for the next flagship collider. 28 % preferred a circular e^+e^- collider, 15 % a muon collider, 14 % a hadron collider, 8 % a linear e^+e^- collider, whereas 23 % do not report a strong opinion, and 9 % responded *any collider as soon as possible*. It is worth noting that 60 % of ECRs that were active in a future collider collaboration voted for the project they were active in, with the second most common alternative being *any collider as soon as possible*. ECRs also show a large willingness to cooperate: a total of 84 % of respondents are willing to support the outcome of the ESPPU process, even in the case that their preferred collider option is not selected as Plan A.

The responding ECRs did not view the upgrade path of the next flagship collider as a prioritised deciding factor between collider options. When probed further, over 80 % of the respondents thought that the present ESPPU process should not make plans further than 3–4 decades ahead. See Fig. 4. This is reflected in the fact that ECRs call for a timely decision of the next flagship collider, including prioritised options in case the first option is rejected (for any reason). A timely decision will help ECRs plan their future careers, and provide motivation for financing bodies to continue to fund this field. It should be noted, though, that this does not mean that ECRs necessarily prioritise the fastest option, only a fast decision.

ECRs also perceive that the decision process around the next flagship collider option has not been fully transparent and unbiased. On several occasions, prominent representatives of the process have communicated one option as *the default option*, or exerted pressure to conform rather than convincing to agree. ECRs therefore urge the leaders of the ESPPU process to proceed with the ESPPU process with full transparency and no bias towards any project. To produce a credible prioritisation, the criteria that have led to that decision should be presented in a clear way, as the result of a democratic process. Following this, proponents of the prioritised project should gather support collegially among proponents of other projects.

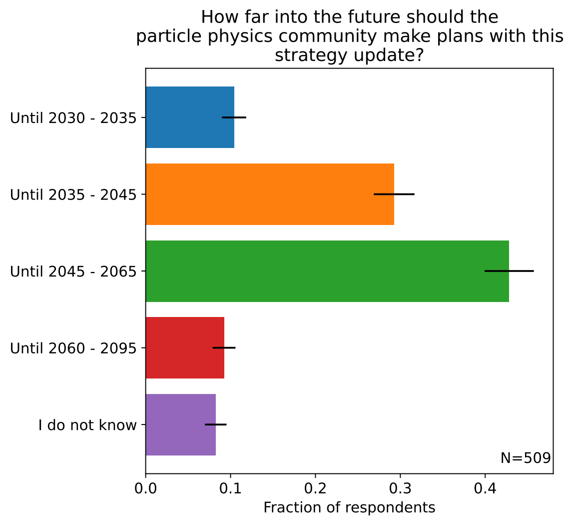

Figure 4: Fraction of respondents on how far into the future the ESPPU should reach. Figure from [5].

6.2 Future Experiments beyond Colliders

The ECR survey for the ESPPU input also covered issues concerning experiments beyond collider projects. A significant majority of respondents agreed that the funding balance between collider and smaller projects should not be changed significantly. When asked what actions would help smaller experiments the most, significant majorities agreed that a dedicated beyond-collider funding scheme, as well as easier transitions between the collider and beyond-collider fields, would benefit smaller experiments *rather much* or *significantly*. Additionally, there was strong support for forming a dedicated panel within ECFA focusing on beyond-collider experiments. This would be in parallel with the CERN PBC (Physics Beyond Colliders) study group, but would widen the scope beyond CERN; an important distinction as the beyond-collider landscape is distributed over Europe [5].

In addition to this, ECRs strongly recommend the ESPPU to concretise its recommendations for the different beyond-collider subfields, similar as it aims to do for the next flagship collider. This includes the pressing measurements, theoretical progress, required instrumentation and research infrastructure for each beyond-collider sub-field, but not a prioritisation between the fields themselves. This will offer career guidance for the ECRs in these fields, as well as provide a well-founded European standpoint to use as motivation for the funding bodies.

7. Conclusions

Particle Physics ECRs face structural challenges that threaten both their well-being and the sustainability of the field. Addressing issues such as short-term contracts, limited career prospects, and lack of mentorship is essential to ensuring a healthy and motivated community. Providing mental health support, valuing non-research contributions, and fostering diversity, equity, and inclusion are equally vital for creating a supportive environment. Moreover, promoting effective science communication and outreach strengthens public trust and inspires the next generation. Finally, ensuring transparency, representation, and engagement of ECRs in strategic decision-making processes will empower them to contribute meaningfully to the future of our field.

European ECRs prioritise an ambitious future flagship collider, where the selection between the options is driven by technological innovation, its foreseen physics baseline program, and the collaborative environment it provides. There is no consensus on which collider option to prioritise, but there is a strong willingness to harmonise after the decision has been made. ECRs call for this decision to be timely, as well as fair and transparent. They also recommend that the budget balance between collider and beyond-collider experiments does not change significangtly, that ECFA should form a beyond-collider panel, and that the ESPPU presents concrete recommendations for the beyond-collider subfields in a similar manner as for collider-based research.

8. Acknowledgements

The authors warmly thank the entire Early-Career Researchers White Paper team for entrusting them with the presentation of this talk, for their constant support and constructive feedbacks.

References

[1] *"Summer 2025 following the Plenary ECFA meeting on 10 July 2025"*, 15th ECFA Newsletter.

[2] *"3rd ECFA workshop on e+e– Higgs, Electroweak, Top factories - ECR session"*, https://indico.in2p3.fr/event/32629/sessions/21697/#20241010 (10 Oct. 2024).

[3] *"ECR Workshop on the European Particle Physics Strategy"*, CERN, https://indi.to/W7d2P (14 Nov. 2024).

[4] *"Symposium on the Early-Career White Paper Input to the European Particle Physics Strategy Update"*, CERN, https://indi.to/bHktX (20 – 21 Feb. 2025).

[5] J. H. Arling *et al.*, *"Early Career Researcher Input to the European Strategy for Particle Physics Update: White Paper"*, arXiv:2503.19862 [hep-ex] (2025).

[6] *"ECRs White Paper input to the 2026 European Strategy Update"*, CERN, https://indi.to/jMhM7 (27 May 2025).

[7] *"Early Career Researcher Input to the European Strategy for Particle Physics Update — Fifty-five recommendations for the future of our field"*, Contribution no. 42, *2026 ESPPU*.

[8] C. Dimitriadi, U. Einhaus, *"ECR perspectives"*, talk presented at the *Open Symposium on the European Strategy for Particle Physics*, Venice, Italy.

[9] *"Support for the Early-Career Researchers White Paper Input to the European Particle Physics Strategy Update"*, https://indi.to/PLdy9

[10] J. Allen *et al.*, *"Results of the 2022 ECFA Early-Career Researchers Panel survey on career prospects and diversity"*, arXiv:2404.02074 [physics.soc-ph] (2024).

[11] *"Equity, Diversity and Inclusion: Strategic Elements of the European Particle Physics Programme"*, Contribution no. 259, *2026 ESPPU*.

[12] *"The Critical Role of Particle Physics Education and Outreach"*, Contribution no. 60, *2026 ESPPU*.

[13] *"Communicating for the future of particle physics"*, Contribution no. 144, *2026 ESPPU*.

[14] *"Empowering particle physics beyond discoveries: a unified European communication strategy for the next generation research infrastructures "*, Contribution no. 66, *2026 ESPPU*.

PoS(EPS-HEP2025)608