PROCEEDINGS OF SCIENCE

Diversity and Inclusion at the LHC

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The Large Hadron Collider is a global effort to unravel the deepest mysteries in fundamental physics. The LHC now spans participation from 600 institutes and universities from around the globe, making it one of the most diverse workplaces in the world. Over the past decade, as our understanding of diversity has broadened, numerous efforts have been initiated at CERN and at the LHC experiments to promote Diversity and Inclusion (D&I). In this paper, I discuss CERN-wide progress as well some of the unique approaches being taken by the experiments towards this goal.

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1. Introduction

Over the past decade, our understanding of diversity has significantly expanded from a focus on physical attributes to include concepts such as gender identity, neurodiversity, and the experiences of minorities. This evolution has influenced how we address diversity and inclusion (D&I) in our workplaces.

While it should not be necessary to justify the importance of inclusion—since anyone who wishes to pursue physics should have that opportunity—we advocate for it because research indicates that diverse teams of problem-solvers perform better overall [1–3]. Moreover, it is important to recognize that D&I initiatives do require time, effort, and funding to be successful.

In this paper, we discuss the tiered D&I efforts at CERN, ranging from broad initiatives to Collaboration management and diversity offices within experiments, all targeting different facets of this complex issue.

2. CERN-wide Diversity Initiatives

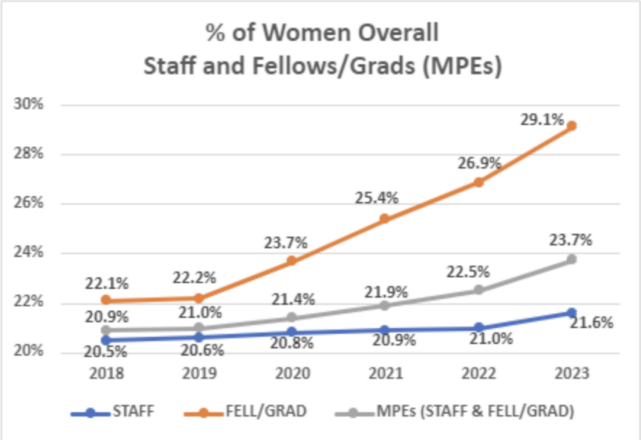

Figure 1: Trends at CERN showing a steady increase in the percentage of women as fellows and members of personel.

CERN has a wide range of diversity initiatives in place including a Diversity and Inclusion office that works towards promoting a diverse and inclusive work environment. Here, we focus on one initiative that was launched in 2020, titled *25 by '25* [4] to increase diversity on two fronts:

- Gender: Increase the percentage of women in the Employed members of the personnel from 21% (as of 31 December 2020) to 25% by the end of 2025.
- Nationality: Ensure that departments within CERN encompass people from diverse nationalities.

This effort has been fairly successful along the gender aspect with the number of women fellows/grads surpassing 25% in 2023 as shown by the orange line in the figure below[1]. While the staff

[1] Updated statistics were shared on the CERN D&I website in July 2024.

numbers are lagging, they also exhibit a steadily increasing trend. This is because staff numbers at the time were at a historic low and staff turn over usually takes longer as compared to grads/fellows which have shorter timelines. This is a clear example of the extent to which these initiatives impact our workspaces and enrich them. CERN-wide initiatives are not limited to the *25 by '25* proposal. There exist a variety of offices with the intention to support its diverse community, such as the Women in Technology group, the Disability Network to name just two. These initiatives showcase the commitment to improving diversity at the CERN level.

3. Diversity Initiatives at the LHC experiments

While CERN-wide initiatives affect everyone at CERN, collaborations are uniquely positioned to pinpoint specific areas that need improvement. To facilitate this, establishing D&I offices within each experiment enables collaborations to conduct self-assessments. Although these offices may have different titles, their primary goal remains consistent: to enhance diversity and inclusion within the collaborations and to support the diverse makeup of these teams. Each Collaboration adopts distinct strategies to tackle these challenges.

3.1 Diversity Initiatives at ALICE

The ALICE Diversity Office promotes inclusion through its constitution, allowing junior representatives to participate in the ALICE Collaboration and management board. Additionally, the junior representatives have a total of three votes in the Collaboration board. This representation enhances participation of its diverse junior community. To further its D&I efforts, ALICE hosts annual workshops, including "Inclusive Workspaces" (initiated in 2020) targeted at management to equip them with skills to enable them to foster inclusive work environments. This year, ALICE launched a new workshop titled "Collaborating in Culturally Diverse Teams" to improve cross-cultural communication among collaborators. This initiative stems from the recognition that miscommunication, rather than malicious intent, often leads to unpleasant interactions. This initiative is part of the diversity office's expanded focus on well-being.

3.2 Diversity Initiatives at ATLAS

The ATLAS Collaboration promotes its D&I by allowing individuals to add pronouns to their GLANCE profiles, helping them identify themselves and reducing the risk of misgendering. This initiative has inspired other Collaborations to implement this as well. Outreach is crucial for sharing our scientific work with the public and fostering a diverse scientific community. While distinct from D&I efforts, it plays a vital role in promoting diversity [5]. The ATLAS Collaboration engages in several outreach efforts that also aim to increase diversity, including creating educational materials in multiple languages for all experience levels. This approach makes LHC physics accessible and highlights the diversity of our community.

3.3 Diversity Initiatives at CMS

A key aspect of any D&I initiative is making concepts of D&I accessible. The CMS Collaboration addresses this with an online handbook [6], available to all as a valuable resource for those

seeking to understand these ideas. Improving diversity in management roles can have a positive trickle-down effect; in 2020, CMS established a task force on D&I to recommend strategies for creating a more diverse management team. In addition to these efforts, CMS has developed a CMS Style for plots that accommodates individuals with color blindness, enhancing physical accessibility [7, 8]. Since color plays a crucial role in communicating ideas, this initiative will have a lasting impact and will be enforced for all CMS plots moving forward, further promoting overall accessibility.

3.4 Diversity Initiatives at LHCb

Established in 2012, the Early Career, Gender & Diversity Office (ECGD) supports early career scientists, with “early career" loosely defined to encourage participation. As individuals advance, the expectation is that they will transition out of the space. Research shows that dedicated mentorship at this stage is crucial for retaining underrepresented minorities [9], providing them a safe environment to learn, grow, and navigate their careers without judgment. The Laura Bassi Group, established in 2019, offers Collaboration members an informal network to discuss underrepresentation in high-energy physics. This dedicated space fosters a sense of community, helping individuals feel less isolated in their experiences.

4. Data for a Top Down Approach to D&I

To employ a top-down approach, it is important to know which areas need improvement. To this end, statistics help highlight the impact of intersectional identities on diversity in physics. A crucial task that diversity offices perform is collecting and analyzing data to identify areas for improvement within the Collaboration. This is essential for pinpointing where most effort is needed. Each office provides yearly statistics to inform the Collaboration’s progress. An example of one such statistic is shown in Fig.2. Note that, in this figure, “women” refers to the heteronormative gender binary as defined in the CERN database. The bottom panel of the figure shows that the fraction of women authors shows an increasing trend, but at varying rates. Additionally, the fraction of women decreases with age, which may indicate challenges in retaining women in science or reflect improving trends among younger women.

Once these areas are identified, it takes combined effort from the diversity offices and the Collaboration management to employ initiatives that can remedy these issues. Management can significantly influence diversity initiatives within experiments and set the tone for what is expected of its collaborators. By supporting diversity initiatives, management can directly impact the culture of any organization. A few examples of such positive measures include: selecting a diverse population for talks and management roles, planning meetings with enough notice so that collaborators can get visas in time, ensuring that venues are accessible to individuals with disabilities, providing childcare[2] so that collaborators can participate without stress of figuring out childcare, and allocating funds to collaborators from countries with limited scientific funding[3]. While this is not an exhaustive list of measures, it offers some insight into the kind of initiatives that members have benefited from.

[2] kudos to LHCP for this.

[3] LHCP early career grants made the conference accessible for many early career scientists.

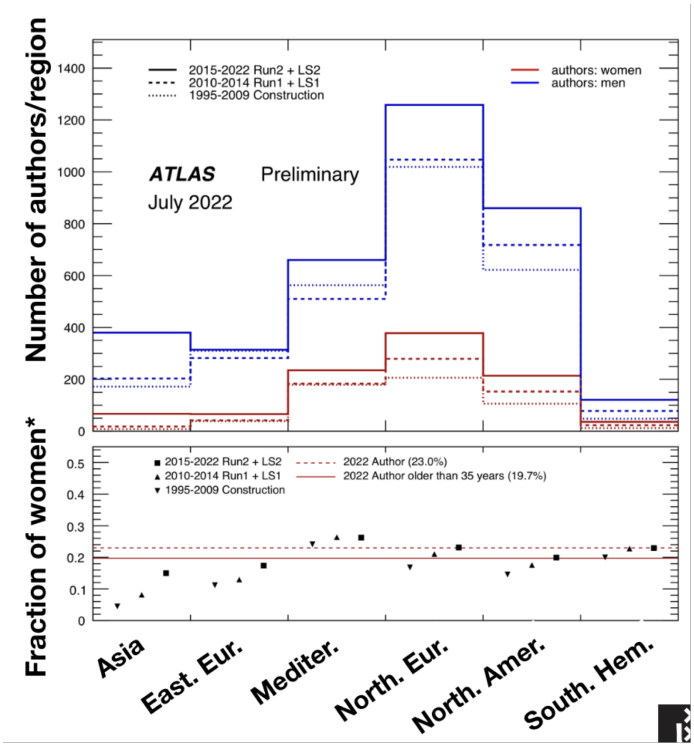

Figure 2: Statistics from the ATLAS Collaboration show that the fraction of women is increasing overall albeit at varying rates.

5. Looking to the future

D&I efforts at the LHC are diverse and steadily progressing both within the experiments and at a CERN-wide level. However, a crucial element often overlooked in these discussions is equity. It is important to consider how we can make the LHC a more equitable space for everyone.

Underrepresented groups cannot address the issue of underrepresentation alone—just as water cannot fix a leaky pipe. Many of us have been affected by D&I issues, underscoring the need to educate ourselves about these challenges and the experiences of minority groups to foster meaningful change. We must prioritize educating our peers about Diversity, Equity, and Inclusion.

As we move forward, our scientific endeavors will only benefit from scientists operating in environments where they feel a sense of belonging. We should celebrate the strides we have made while acknowledging that we have a long way to go in making equity a priority and creating a truly inclusive environment for all.

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