



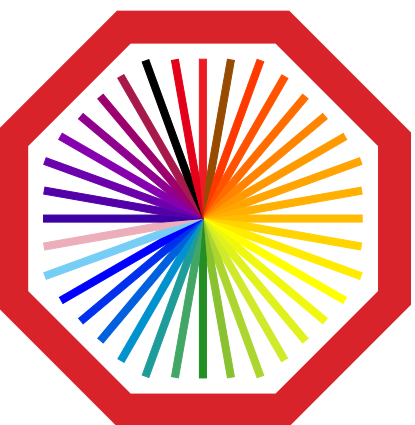
# Diversity & Inclusion at the LHC

**LHCP 2024**

*"What we do is more important than what we say or what we say we believe"*

*- Bell Hooks*

**Ananya Rai (ALICE) on behalf of the LHC experiments**  
[ananya.raai@cern.ch](mailto:ananya.raai@cern.ch)



**ALICE**



**Yale**

# Diversity

## What and why?

Diversity solely based on physical aspects such as gender: 3%

1927



2024



# Diversity

## What and why?

**Diversity:** the quality of being different.

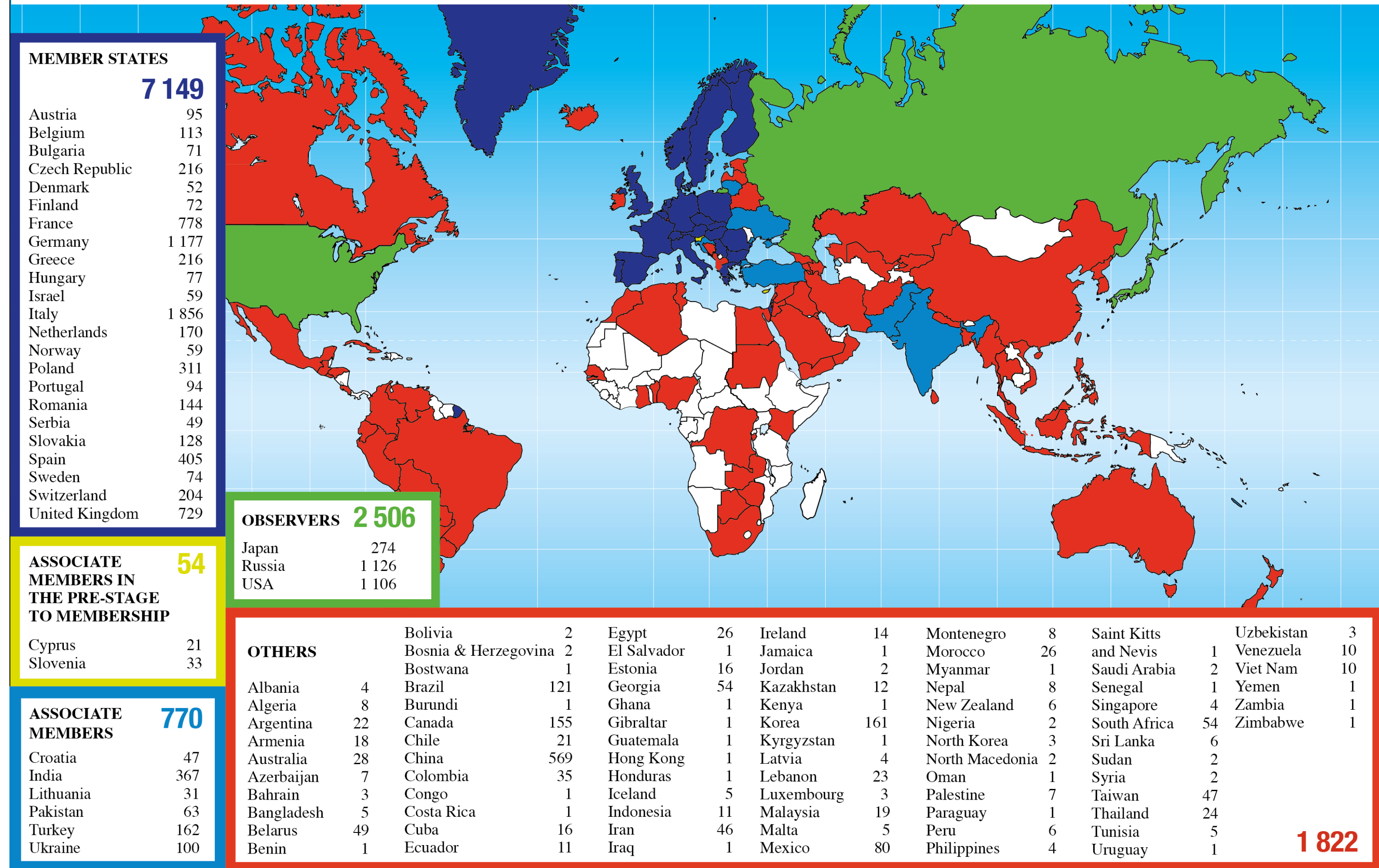
But in the last 10 years, we have expanded our focus to

- Neurodiversity

- Gender identity

- Experiences of black, indigenous, people of color

Distribution of All CERN Users by Nationality on 27 January 2020



Credit: CERN

# Sounds great but why should we care?

## Inclusion for better science

- **Inclusion:** making people feel that they belong.
- Anyone interested in physics should be able to do physics.  
**But this is not our reality!**
- Research shows that having a diverse group of problem solvers yields best results!

## The Diversity–Innovation Paradox in Science

Bas Hofstra<sup>a,1</sup>, Vivek V. Kulkarni<sup>b</sup>, Sebastian Munoz-Najar Galvez<sup>a</sup>, Bryan He<sup>b</sup>, Dan Jurafsky<sup>b,c</sup>, and Daniel A. McFarland<sup>a,1</sup>

<sup>a</sup>Graduate School of Education, Stanford University, Stanford, CA 94305; <sup>b</sup>Department of Computer Science, Stanford University, Stanford, CA 94305; and <sup>c</sup>Department of Linguistics, Stanford University, Stanford, CA 94305



## Groups of diverse problem solvers can outperform groups of high-ability problem solvers

Lu Hong<sup>†\*§</sup> and Scott E. Page<sup>¶</sup>

<sup>†</sup>Michigan Business School and <sup>¶</sup>Complex Systems, University of Michigan, Ann Arbor, MI 48109-1234; and <sup>§</sup>Department of Finance, Loyola University, Chicago, IL 60611

## The preeminence of ethnic diversity in scientific collaboration

[Bedoor K. AlShebli](#) , [Talal Rahwan](#)  & [Wei Lee Woon](#) 

*Nature Communications* **9**, Article number: 5163 (2018) | [Cite this article](#)

35k Accesses | 245 Citations | 721 Altmetric | [Metrics](#)

### Abstract

Inspired by the social and economic benefits of diversity, we analyze over 9 million papers and 6 million scientists to study the relationship between research impact and five classes of diversity: ethnicity, discipline, gender, affiliation, and academic age. Using randomized baseline models, we establish the presence of homophily in ethnicity, gender and affiliation. We then study the effect of diversity on scientific impact, as reflected in citations. Remarkably, of the classes considered, ethnic diversity had the strongest correlation with

19)  
(14), and the sub-  
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red for review May 25, 2004)

ally diverse groups outperform homoge-  
also been shown that functionally diverse  
form the best individual agents, provided  
p are nearly as good (1). These results still  
ant question: Can a functionally diverse  
s have less ability outperform a group of  
ty who may themselves be diverse? The

# Diversity & Inclusion at CERN

## Tiered D&I efforts at CERN

CERN

COLLABORATION MANAGEMENT

DIVERSITY OFFICES

YOU



# CERN Diversity Initiatives



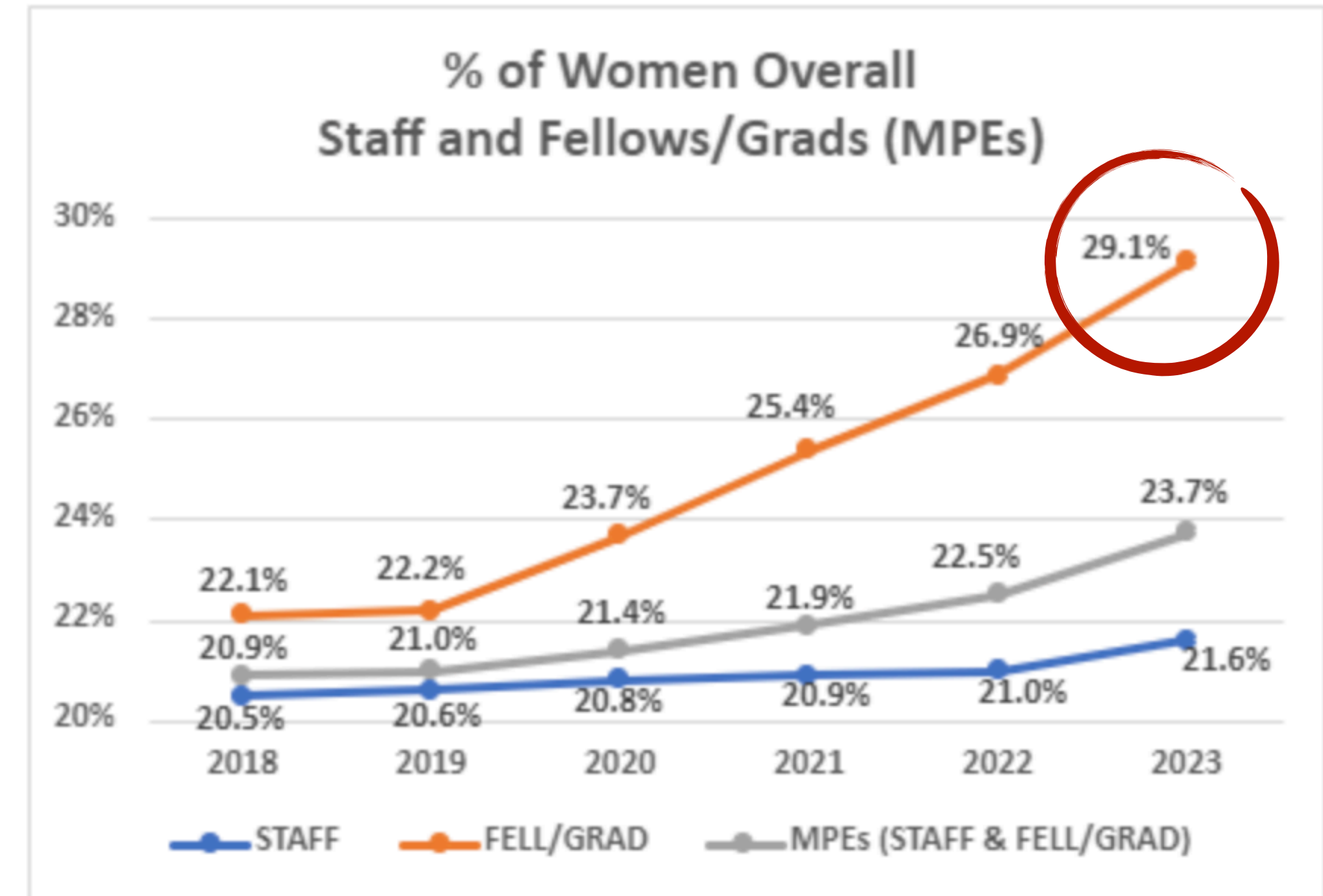
# Diversity Initiatives at CERN

Credit: CERN D&I

## Past and present

### • CERN 25 by 25:

1. 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.
2. Diversify by nationality.



### • CERN Code of Conduct

### • CERN offices



# Diversity & Inclusion Initiatives at Experiments

*The diversity of diversity initiatives at the LHC*





# Initiatives at ALICE

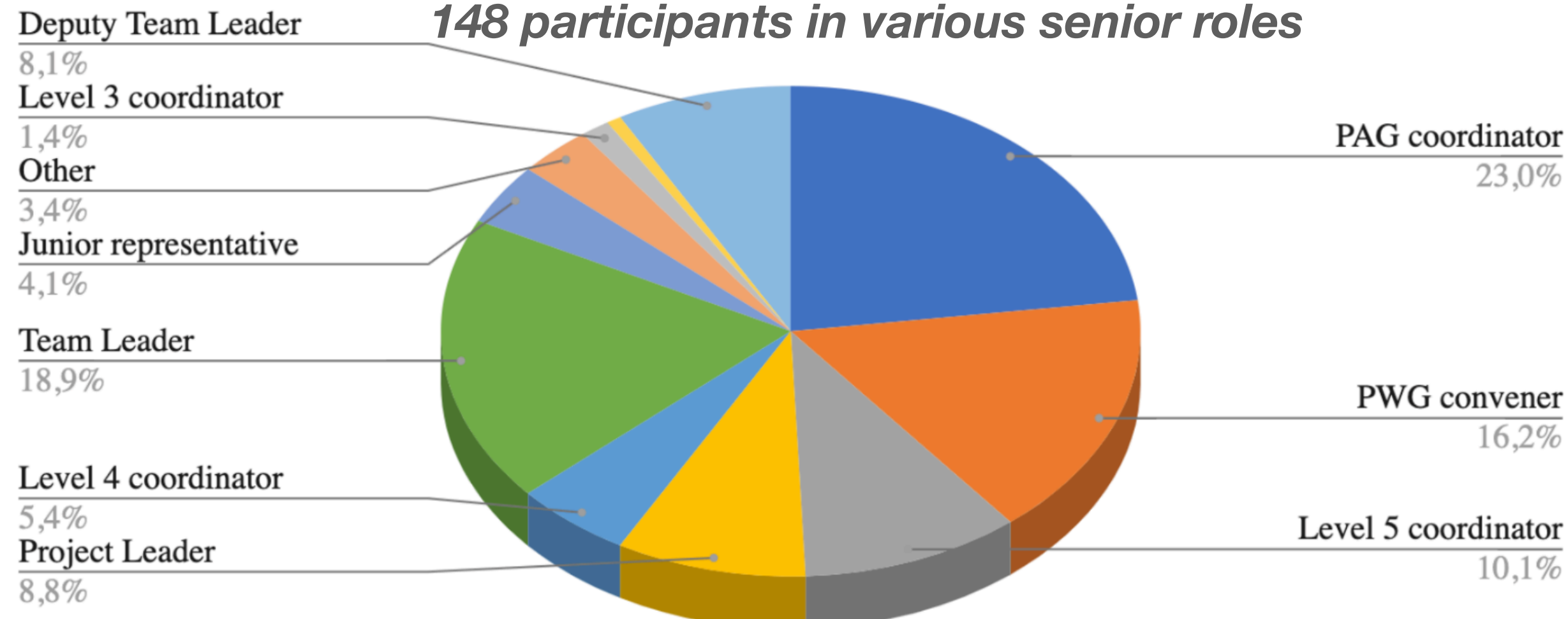
## ALICE Diversity Office: Past & Present

- ALICE juniors representatives **have a vote in collaboration board & management board** (2013-).
- Training for management roles to promote inclusivity at ALICE (offered yearly), **funded by ALICE** (2020-).

### “Inclusive Workspaces”

Statistics from ALICE Inclusive Workspaces Workshop (2020-23)

148 participants in various senior roles



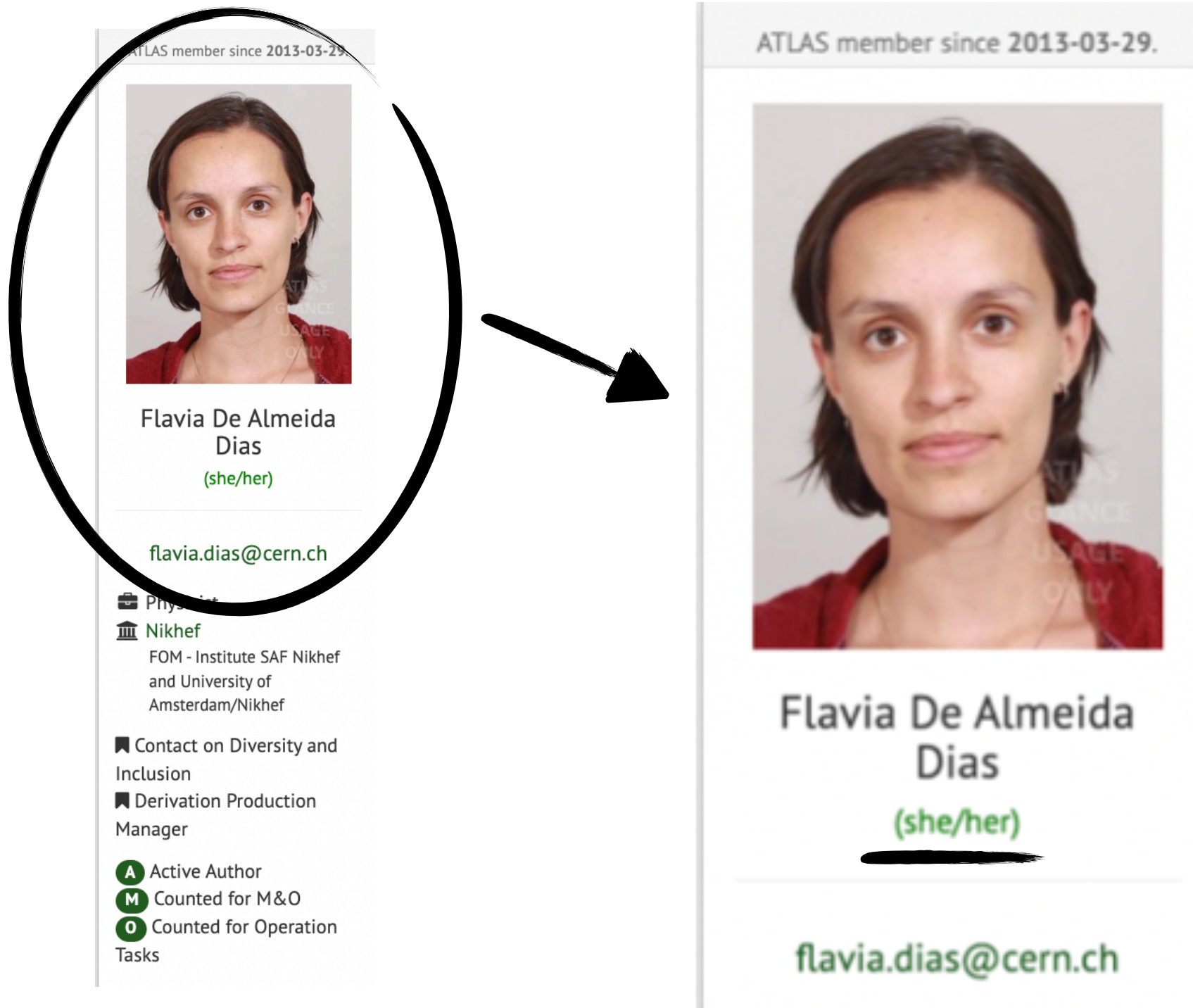
- Focus is on **well-being**.
- Initiative to **improve cross-cultural communication** within the collaboration via a new workshop. (First run during ALICE week in March, 2024)

### “Collaborating in Culturally Diverse Teams”

# Initiatives at ATLAS

## Past and present

- Use of **pronouns** in the ATLAS GLANCE database (2024).



- **Outreach** is essential to communicate our scientific endeavors to the general public & to create a more diverse scientific community.
- **Educational material:** books, fact sheets etc. for all levels, in **various languages.**



\*All LHC experiments have active outreach efforts

# Initiatives at CMS

## CMS Diversity & Inclusion Office: Past and present

- ***Handbook*** available online.
- ***Task Force on Diversity & Inclusion*** (2020) to make recommendations for appointing a more diverse management body.
- ***Color palette for color blindness*** (2024): Enforcing a **CMS style** that ensures plots are **accessible** to people with color blindness.



**EXPLORING DIVERSITY & INCLUSION**

BY THE CMS DIVERSITY & INCLUSION OFFICE

### WHAT IS COLOUR-BLINDNESS?



Colour blindness or Colour Vision Deficiency (CVD) is a predominantly inherited condition that affects the cones in our eyes, which are sensitive to colour.

- ☀ Affects more than 300 millions people worldwide
- ☀ 1 in 12 males and 1 in 200 females are affected
- ☀ Currently no cure available

Normal vision Deuteranopia  
Protanopia Tritanopia

*What can we do to help?*

THERE ARE MANY TYPES OF CVD

Learn more:



- Avoid using colour solely to distinguish categories
- Try not to use red and green together
- Use CVD-friendly palettes!
- Check your slides are clear when viewed in greyscale

04

# Initiatives at LHCb

## Early Career, Gender & Diversity Office: Past and present

- Focus on **early career scientists** (2012-)  
retention of underrepresented minorities is positively influenced by **dedicated mentorship** early in their careers.

- **Laura Bassi Group** (2019-)  
Focus on underrepresentation in HEP.  
**Informal network** — crucial as this allows minorities to have safe spaces to share experiences.



### Early Career, Gender and Diversity Office: Weekly Newsletter

[LHCb homepage](#) > [ECGD homepage](#) > [ECGD newsletter 2023](#)

We prepare an ECGD newsletter, which the LHCb secretariat kindly attaches to the [Weekly News](#) that they circulate on Friday afternoons. For ease of access, we also collect these newsletters here below.

Please [contact us](#) if you have news that you would like us to include into one of our upcoming newsletters.

2024:  
[Jan 12](#) | [Jan 19](#)  
[Feb 9](#) | [Feb 16](#)  
[Mar 1](#)

**1 March 2024**

**Bringing eclipsed women of astronomy and physics into the light:**

<https://www.symmetrymagazine.org/article/bringing-eclipsed-women-of-astronomy-and-physics-into-the-l>

**16 February 2024**

**Ethics at CERN:**

At CERN, our ethics-related framework aims to guide us to act in accordance with the Organization's values and the c establish and maintain a respectful working environment. There is a new webpage on ethics at CERN bringing together <https://hr.web.cern.ch/ethics> <https://home.cern/news/announcement/cern/new-webpage-ethics-cern>

**9 February 2024**

**Support for black physics students:**

<https://physicsworld.com/a/why-we-need-the-physics-community-to-play-a-greater-role-in-supporting-bla>  
**Gender equality can be the route to a better world:**  
<https://www.nature.com/articles/d41586-023-02745-9>

**19 January 2024**

**FIRST-EVER CERN Alumni Jobs Fair**

The FIRST-EVER CERN Alumni Jobs Fair will take place at the Third Collisions event at CERN (9-11 February 2024). F



*Laura Bassi: Italian physicist & first woman to have a doctorate in science*

# Statistics

## Backing up facts with numbers



# Informing the collaboration

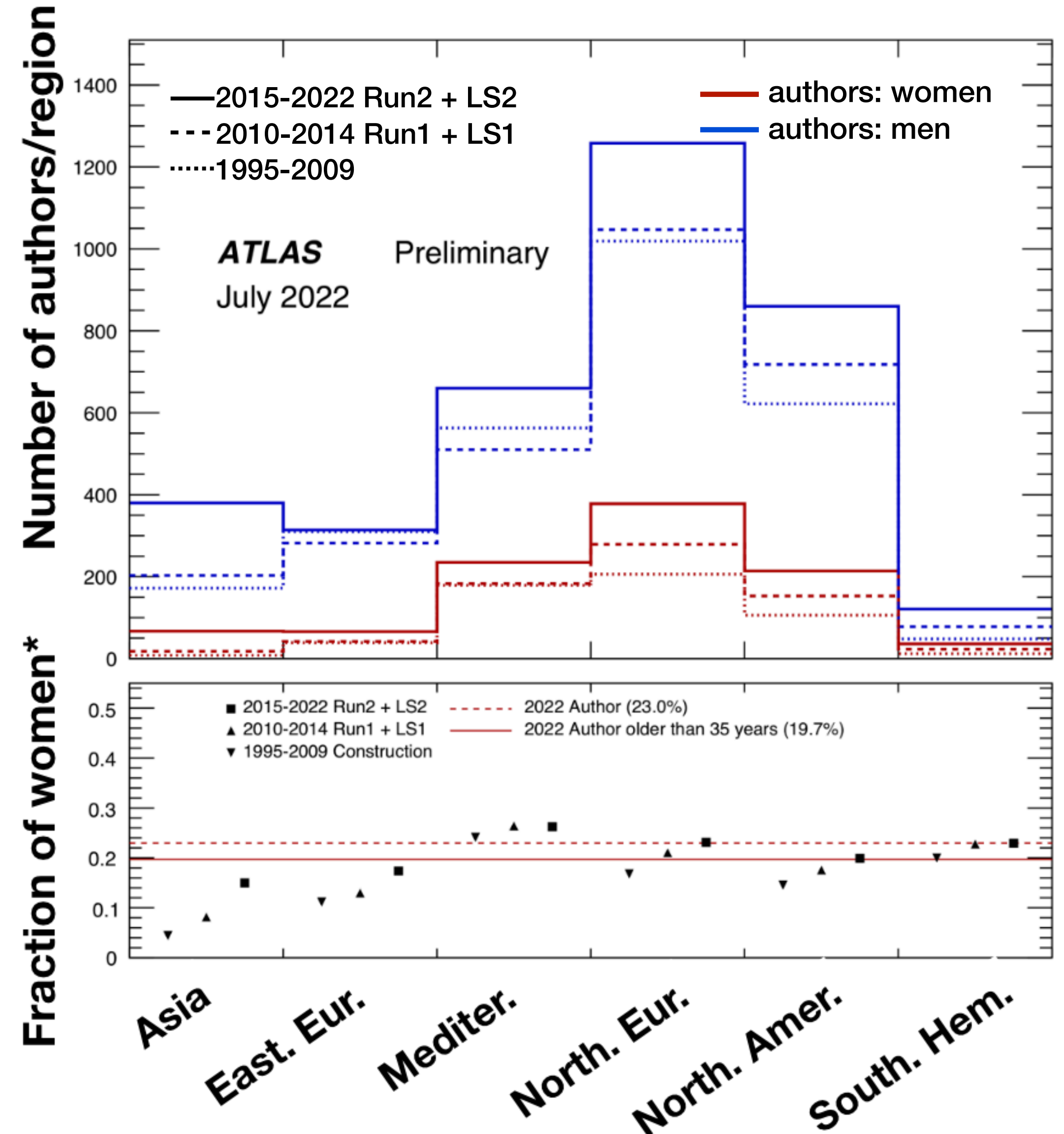
## Studying age, gender & regionality

- 2022 Author (23.0%)
- - - 2022 Author older than 35 years (19.7%)
- 2015-2022 Run2 + LS2
- ▲ 2010-2014 Run1 + LS1
- ▼ 1995-2009 Construction

- Statistics illustrate the impact of intersectional identities on diversity in physics.
- Trends show that the fraction of women\* is growing overall (but at different rates).
- Fraction of women\* authors decreases with age - retention of women\* in science/ improving trends for younger generation?

\*Women refers to heteronormative gender binary as in CERN database.

\*\*All LHC experiments perform similar analyses.



An illustration on a light beige background showing five business professionals of diverse backgrounds climbing a series of five blue rectangular blocks of increasing height from left to right. The tallest block on the right has a man standing on top holding a green flag on a white pole. The other four individuals are in various stages of climbing or standing on the blocks. The man on the tallest block has a yellow sash. The background features stylized white clouds.

# Diversity Initiatives at the Management Level

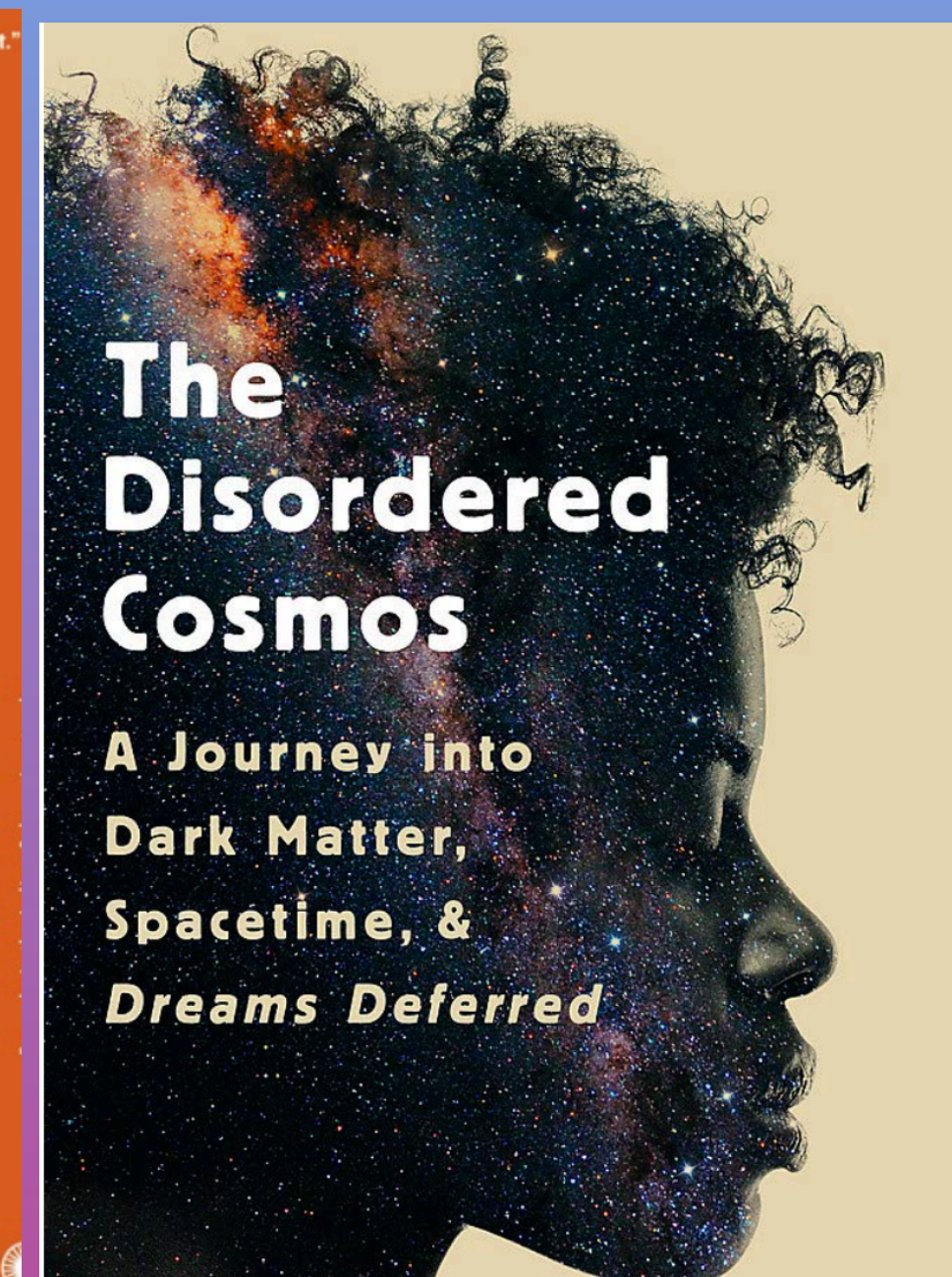
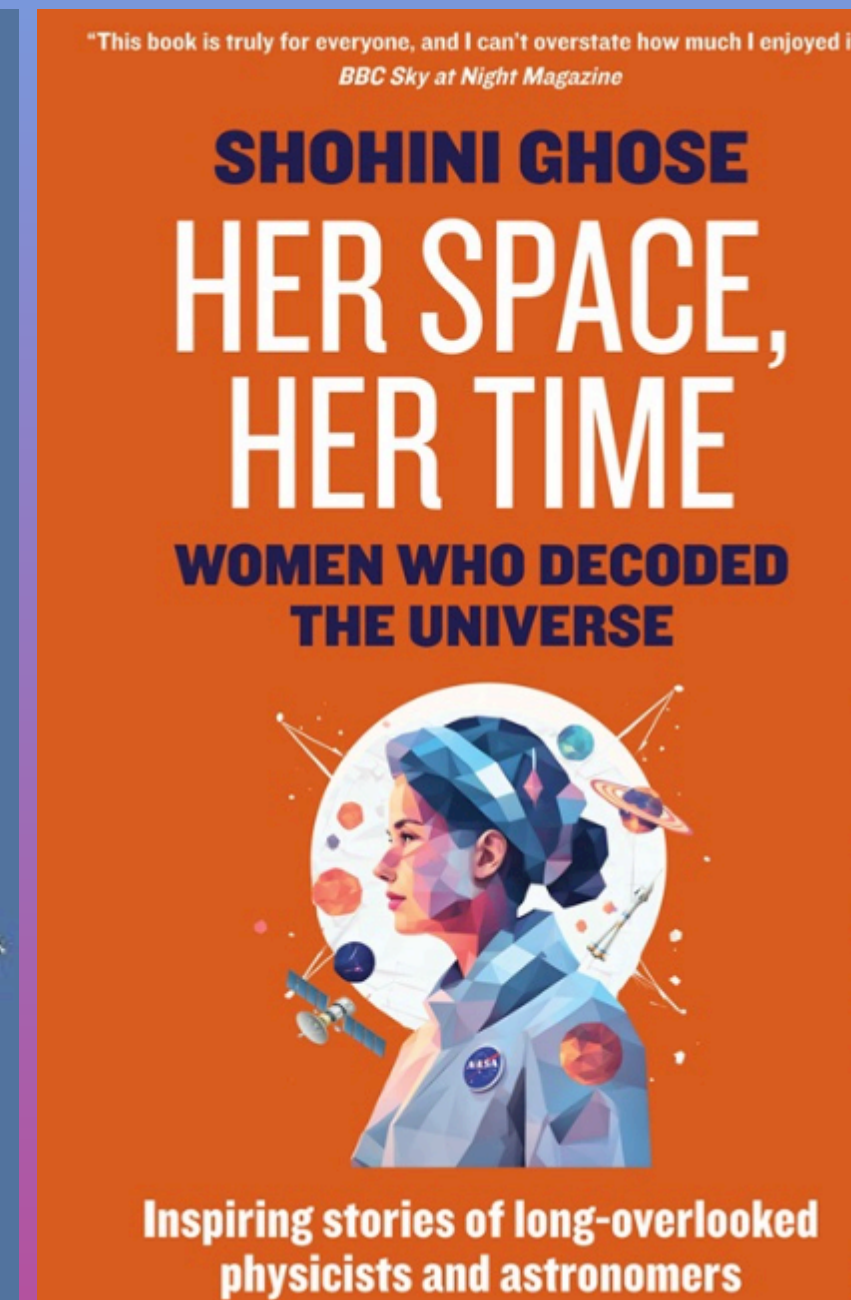
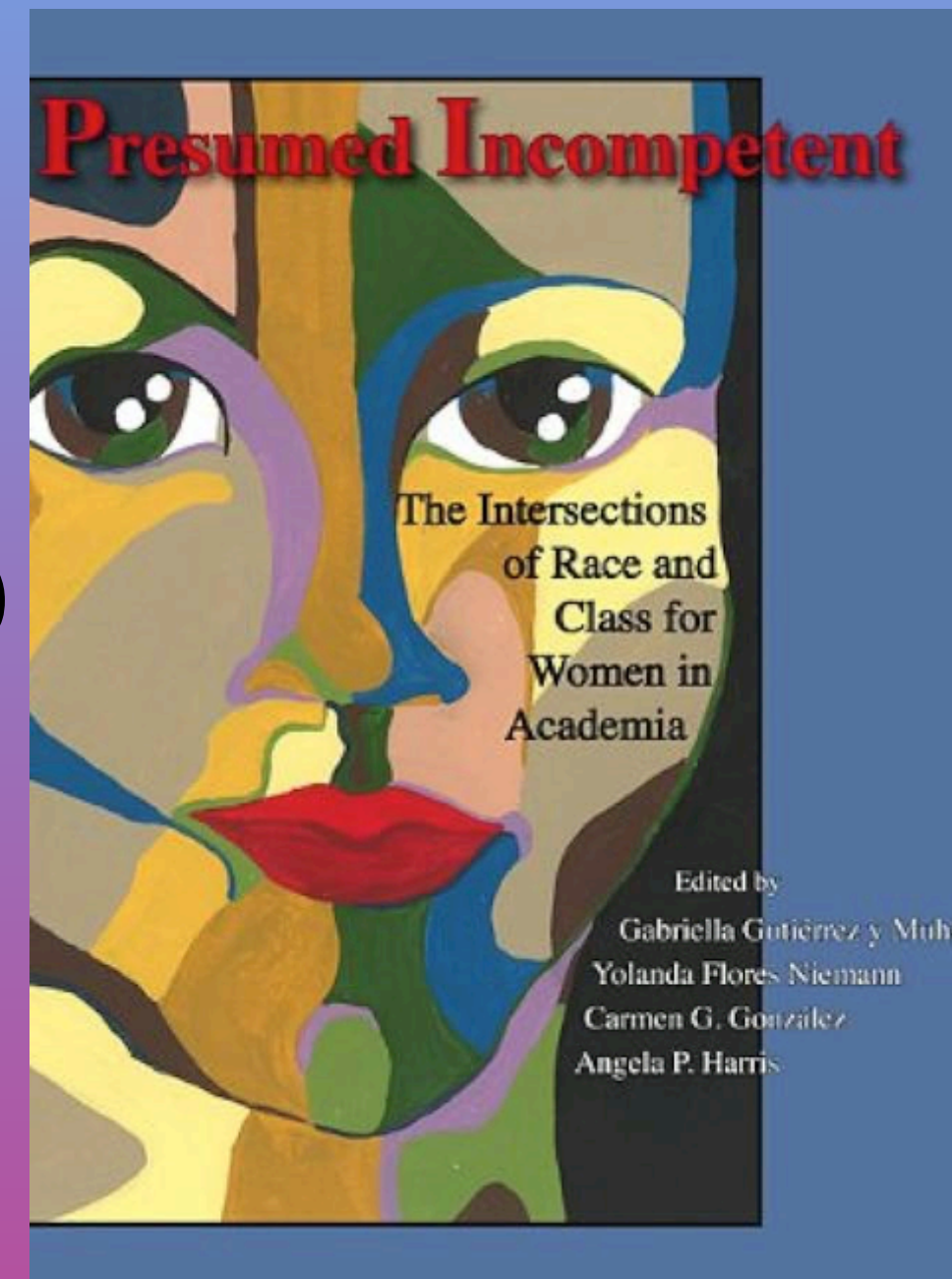
# What can the management do?

## Supporting the collaboration

- **Support** diversity initiatives within your collaborations.
- Consider the diversity of your collaboration when planning collaboration meetings/conferences
  - do all members feel **safe**?
  - is there **childcare**? (*shoutout to LHCP for having childcare!*)
  - is it accessible to people with **disabilities**?
  - **visas** can take time. Consider giving your collaborators enough notice
  - consider **allocating funds** to people from countries with limited scientific funding for travel (*shoutout to LHCP for early career grants!*)
- Take **active** interest in diversity issues within the collaboration. Consider cross-experiment collaboration to tackle diversity issues.



Is this enough?



# What can YOU do?

Answer: A LOT!

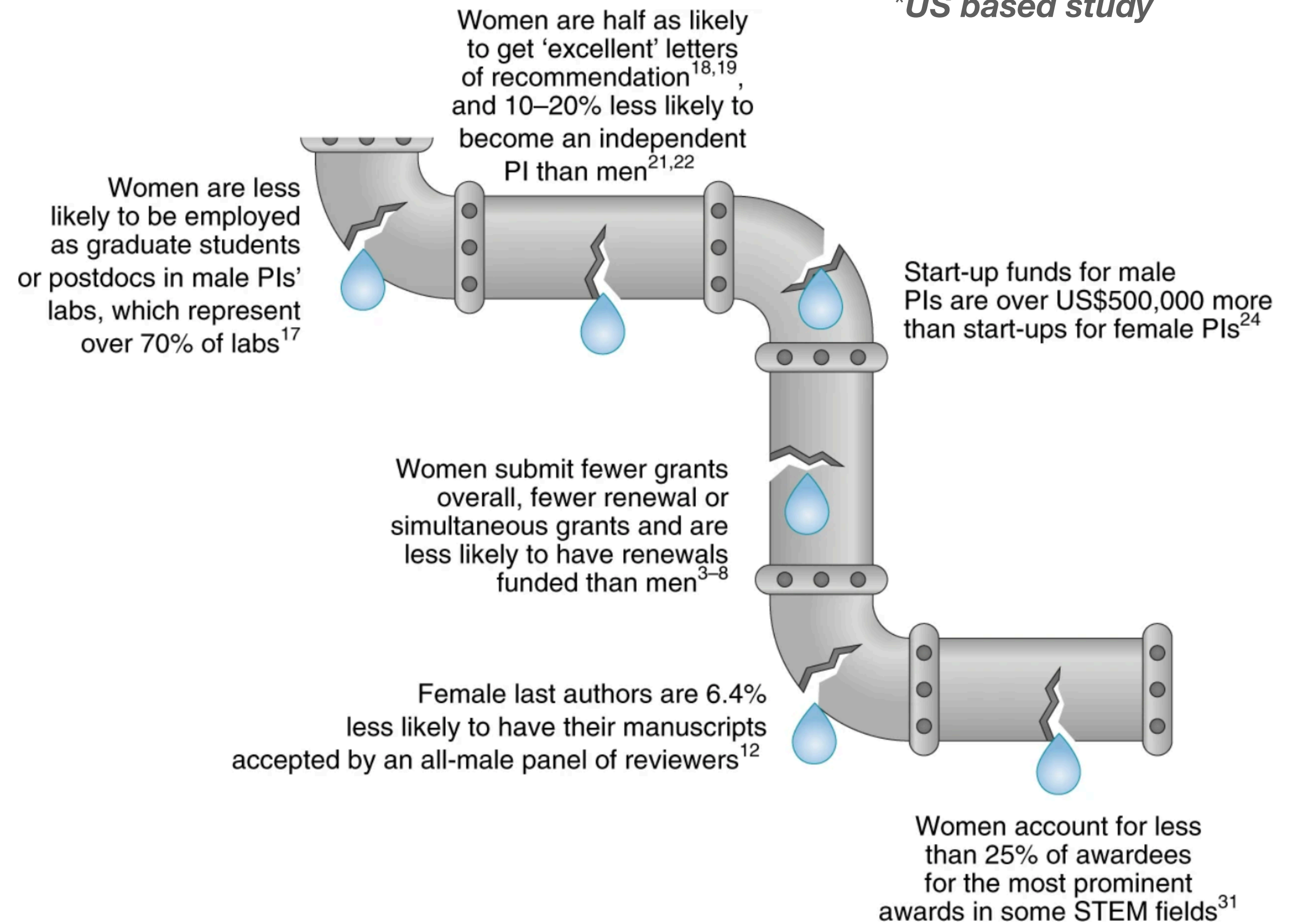
- Underrepresented groups **ALONE** cannot fix the problem of underrepresentation alone — “*water cannot fix a leaky pipe*”
- It is highly likely that you are or know someone who knows someone who knows someone who has been affected by D&I issues.
- **Educate yourself** about D&I and the experiences of minority groups.

minorities

Fig. 1: The leaky pipeline of ~~women~~ in STEM.

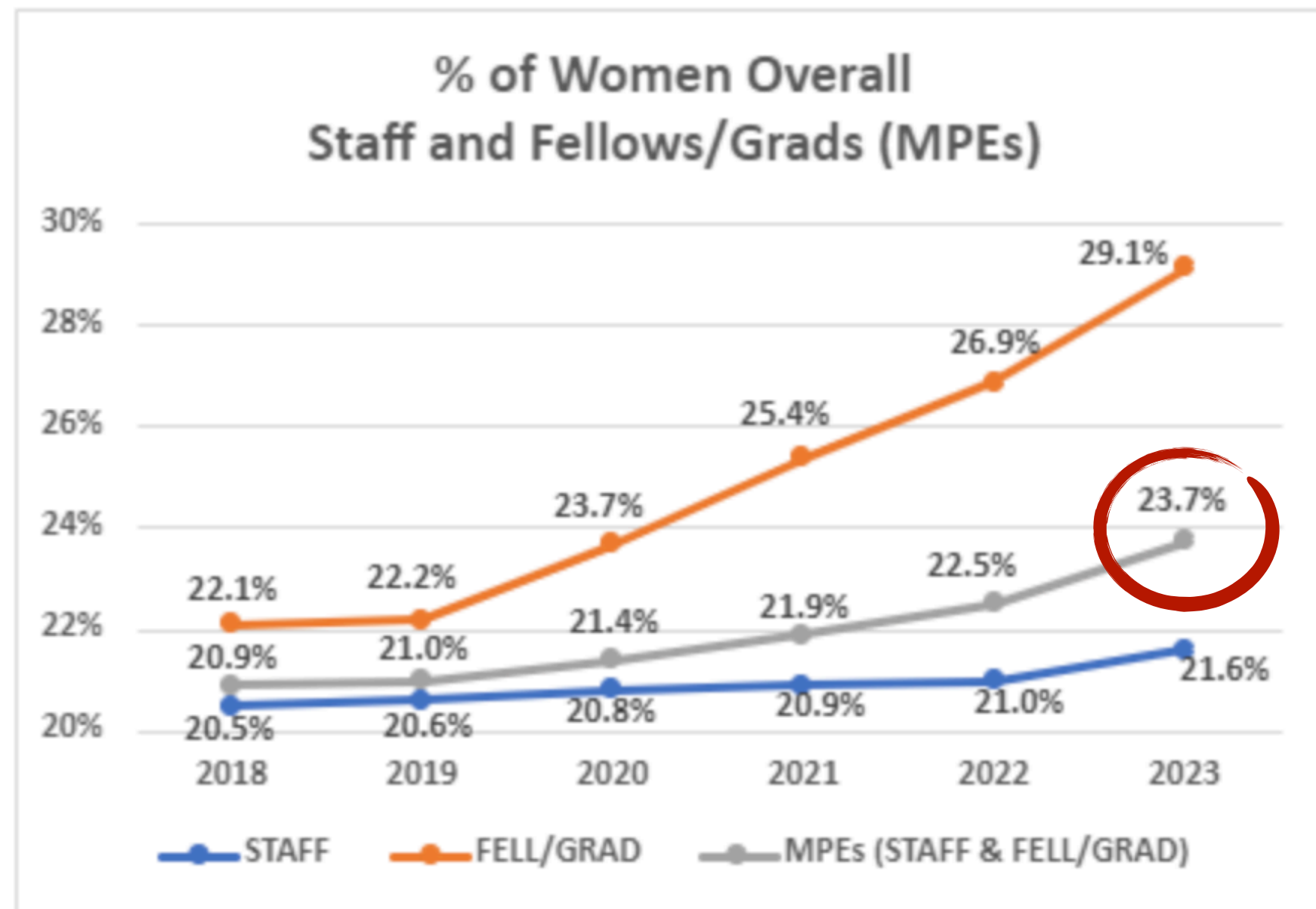
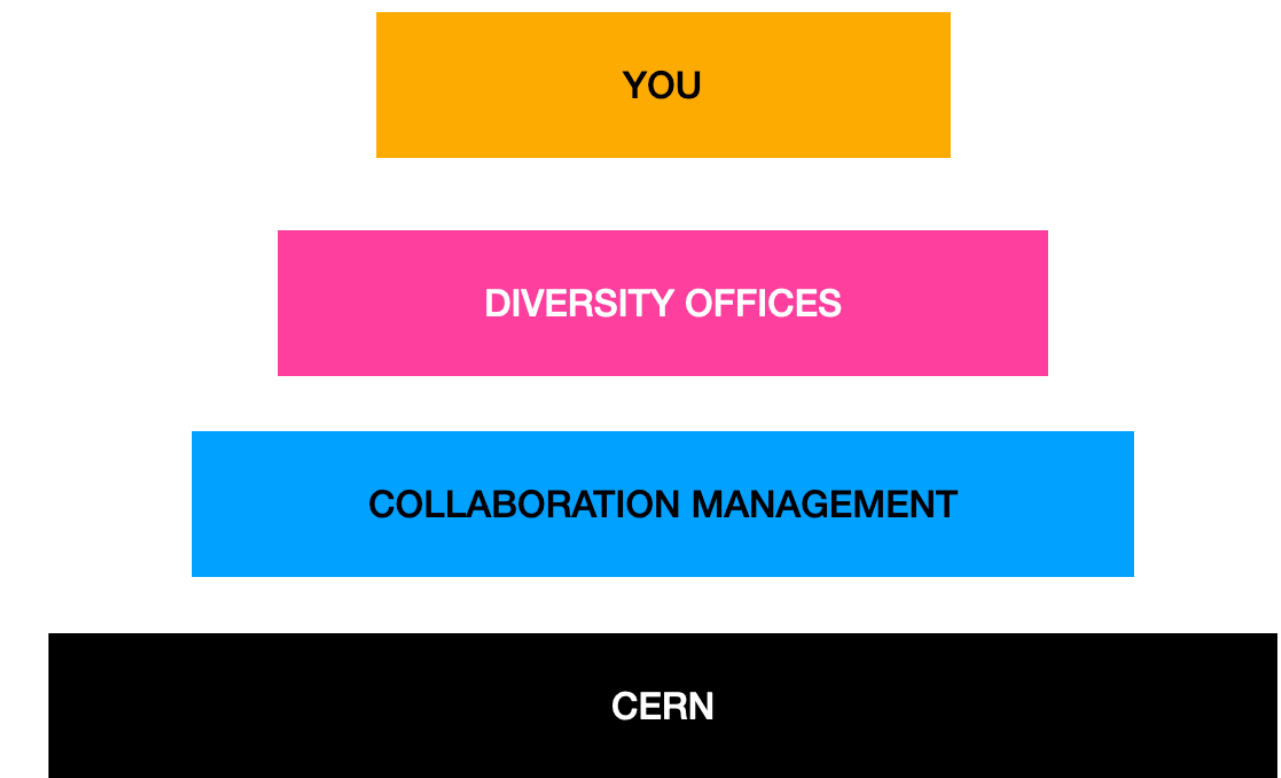
From: [How the entire scientific community can confront gender bias in the workplace](#)

\*US based study

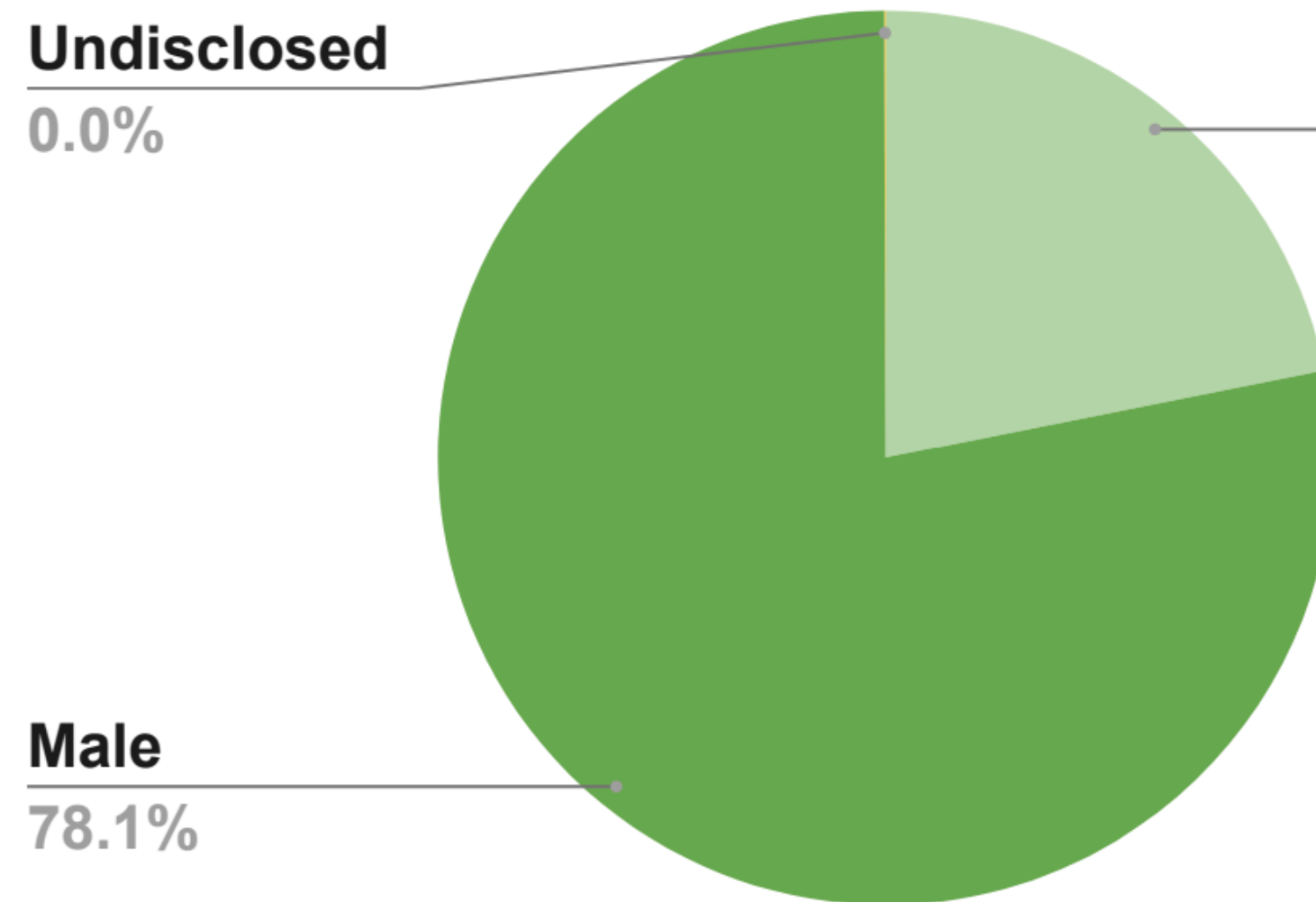


# Looking to the future

## Where can we improve? (very limited thoughts)



Gender distribution in CMS (2023)



Female 21.9%  
 Similar % for most experiments!

### Didn't discuss EQUITY:

- visas take time. Give your collaborators time to plan (*inclusion*)
- consider allocating funds to people from countries with limited scientific funding for travel (*equity*)

Educate ourselves and our peers about Diversity, Equity and Inclusion

Move away from using heteronormative gender in databases

Make colorblind-friendly plotting styles the norm

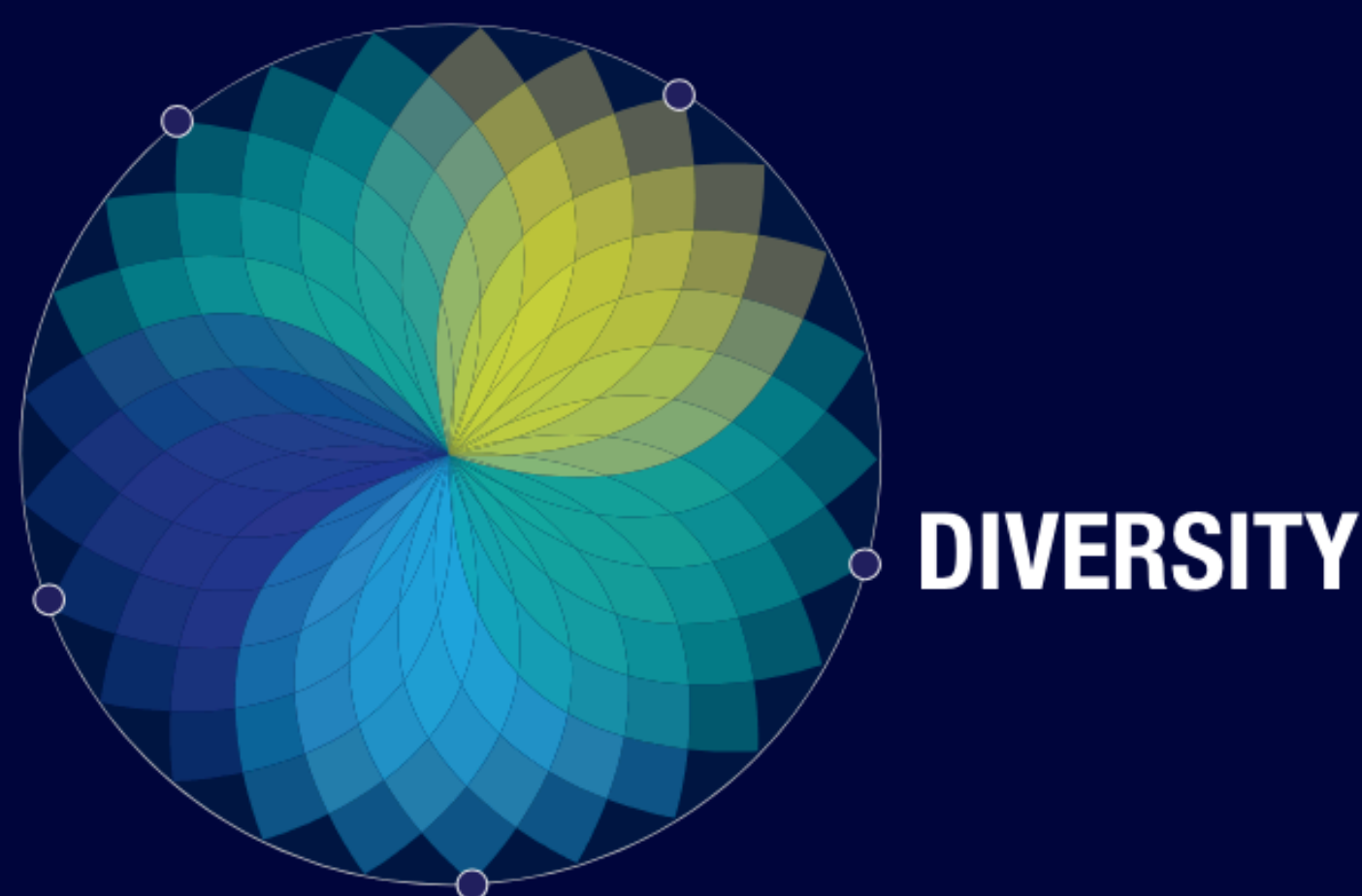
Make EQUITY a priority

***We are making progress but we can do a lot more!***

# Backup

# CERN Code of Conduct

## Guidelines for all CERN users



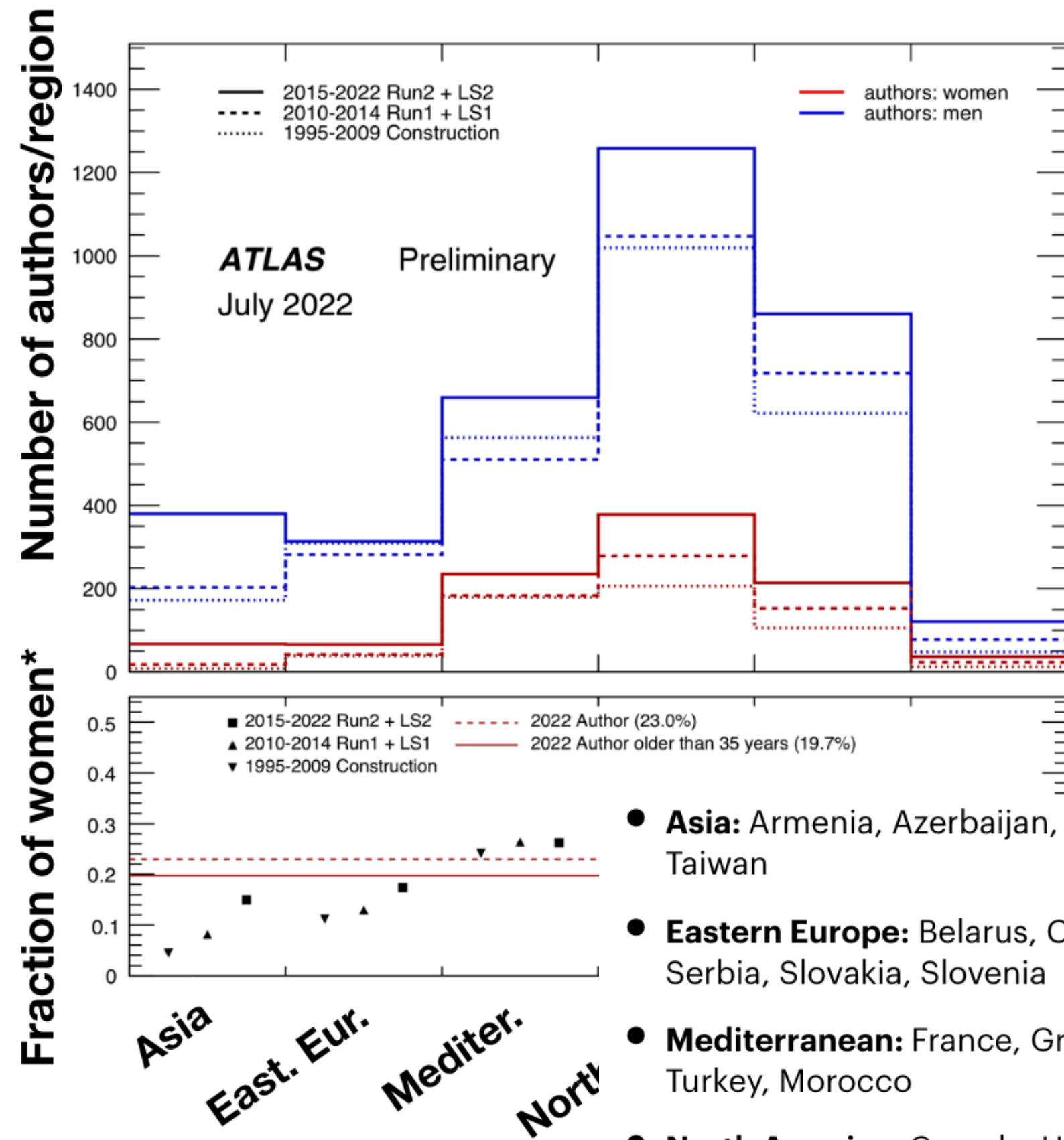
### APPRECIATING DIFFERENCES, FOSTERING EQUALITY, AND PROMOTING COLLABORATION

*CERN's excellence derives from an environment in which the knowledge and perspectives of a diverse workforce are valued and dialogue is encouraged at all levels.*

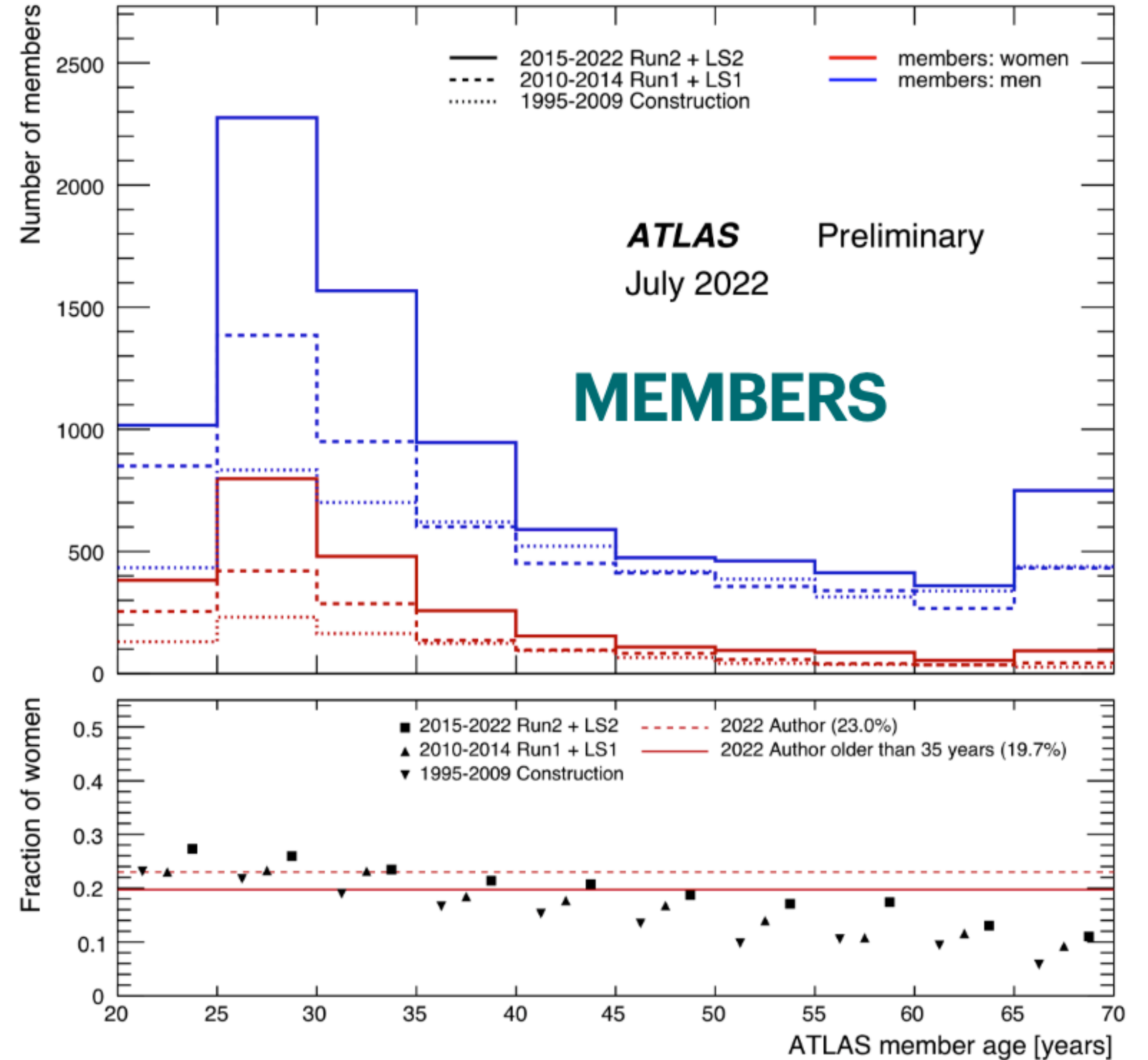
### AS CERN CONTRIBUTORS, WE:

- Respect and value differences.
- Promote inclusiveness in the workplace in terms of both personal characteristics and professional abilities.
- Demonstrate team spirit and invest in team building.
- Treat others with tact, courtesy and respect.
- Abstain from and actively discourage discrimination in all forms.
- Avoid offending others by exercising restraint, and are aware that statements or actions not intended to be offensive to another person may be perceived as such.
- Refrain from unpleasant or disparaging remarks or actions, in particular on the basis of sex, age, religion, beliefs, nationality, culture, ethnicity, race, sexual orientation, status at CERN, disability, or family situation.

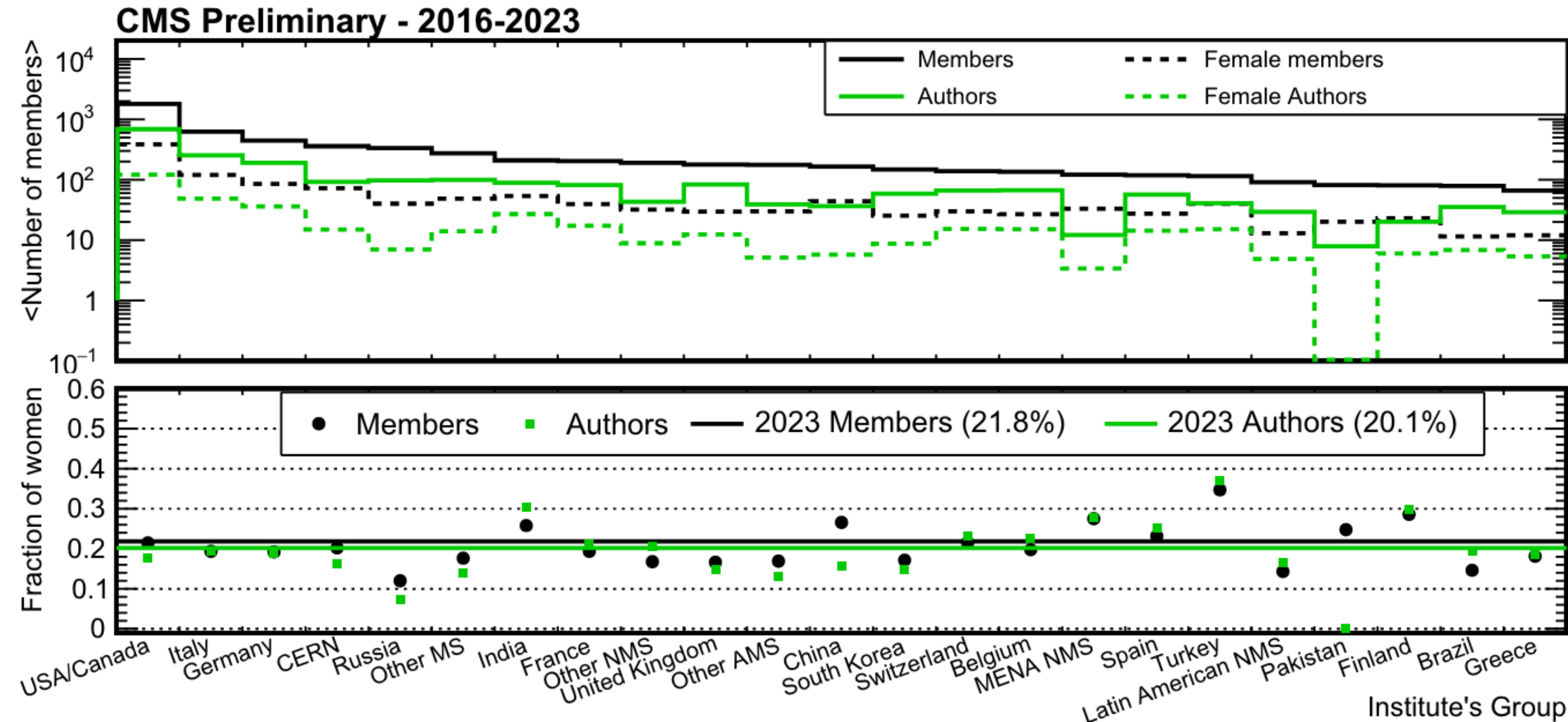
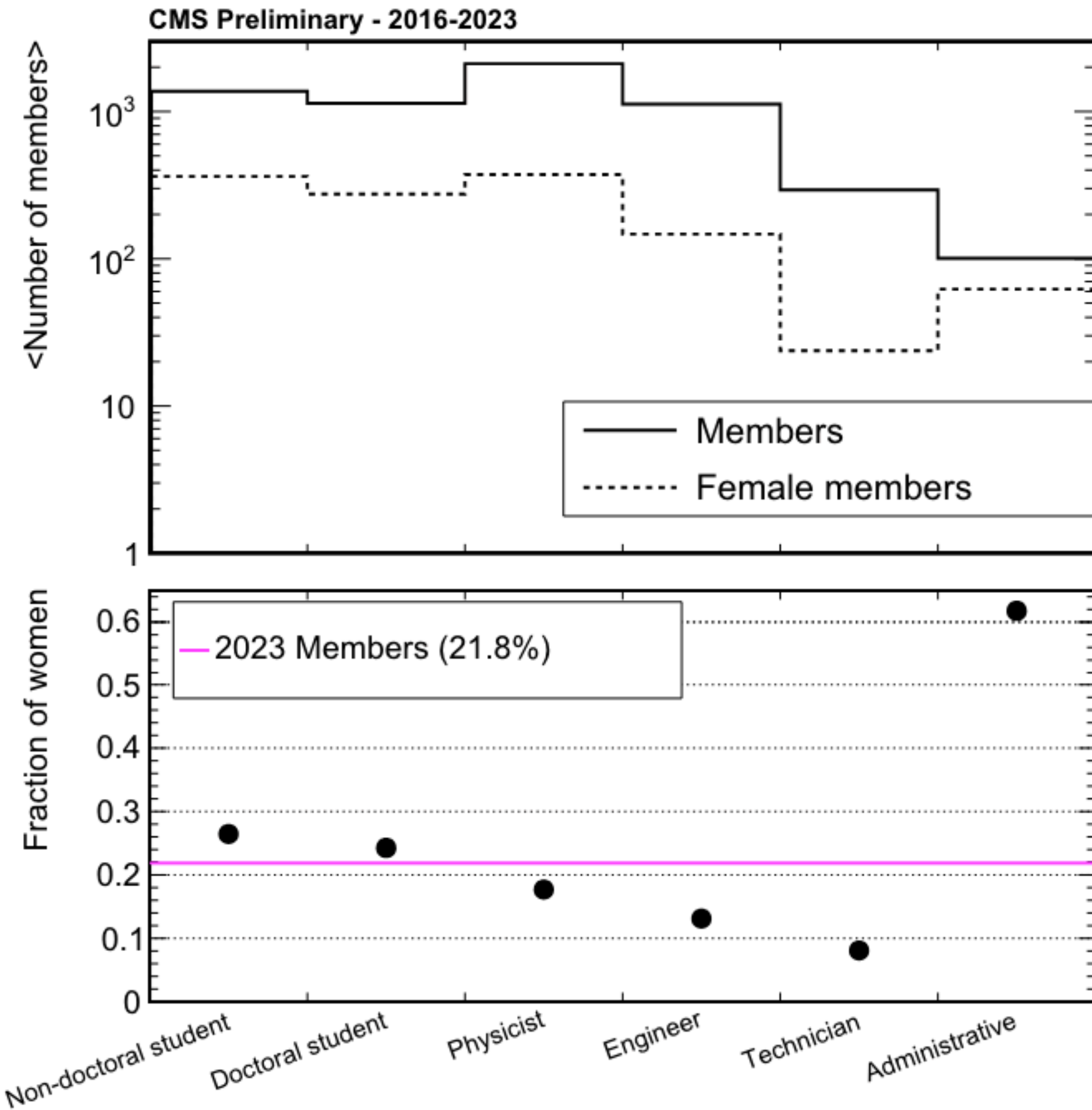
# Info on statistics (ATLAS 2022)



- **Asia:** Armenia, Azerbaijan, China, Georgia, Hong Kong, Japan, Taiwan
- **Eastern Europe:** Belarus, Czechia, Poland, Romania, Russia, Serbia, Slovakia, Slovenia
- **Mediterranean:** France, Greece, Israel, Italy, Portugal, Spain, Turkey, Morocco
- **North America:** Canada, USA
- **Northern Europe:** Austria, Denmark, Germany, the Netherlands, Norway, Sweden, Switzerland (including CERN), UK
- **Southern Hemisphere:** Argentina, Australia, Brazil, Chile, Colombia, South Africa



# Info on statistics (CMS 2023)

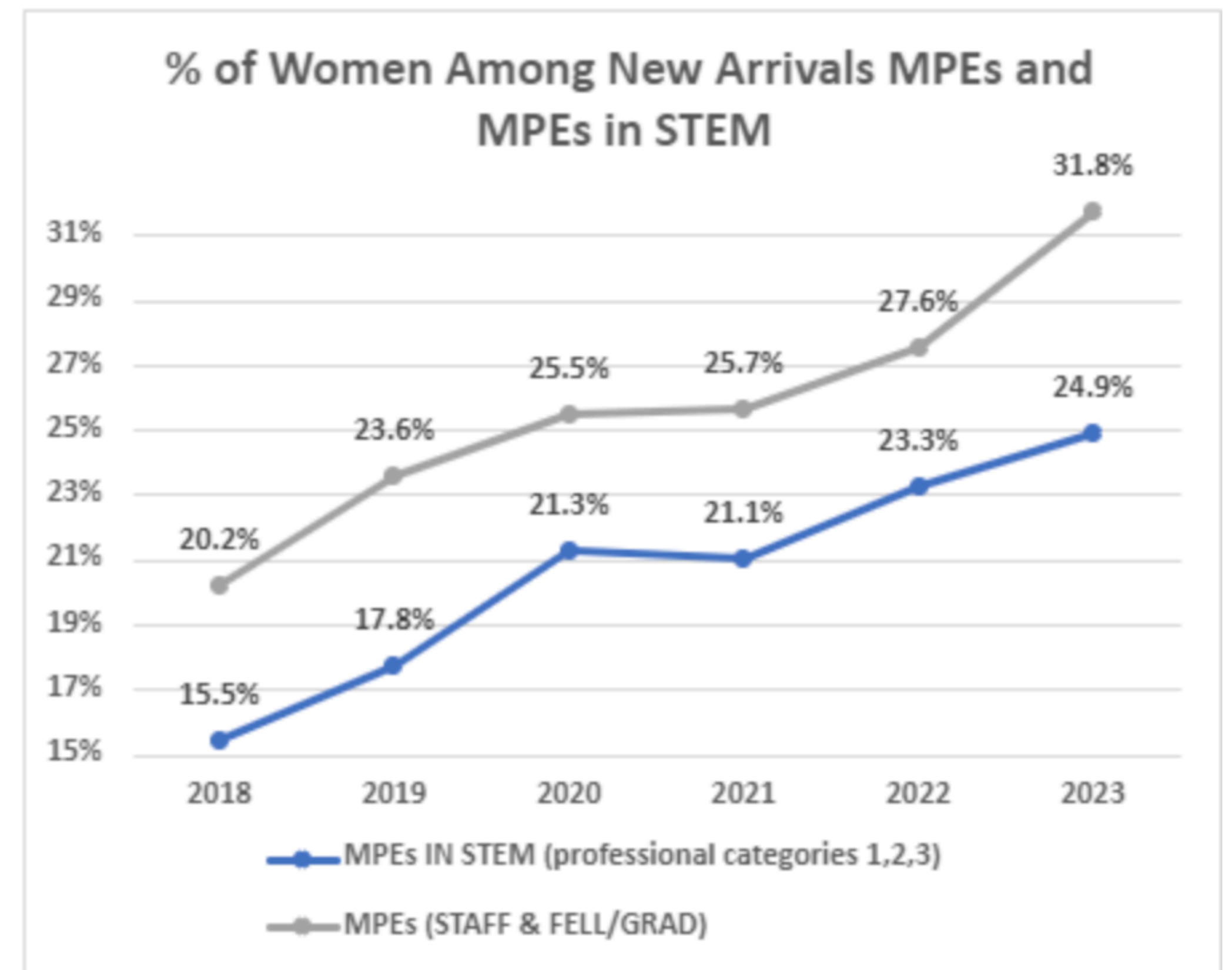
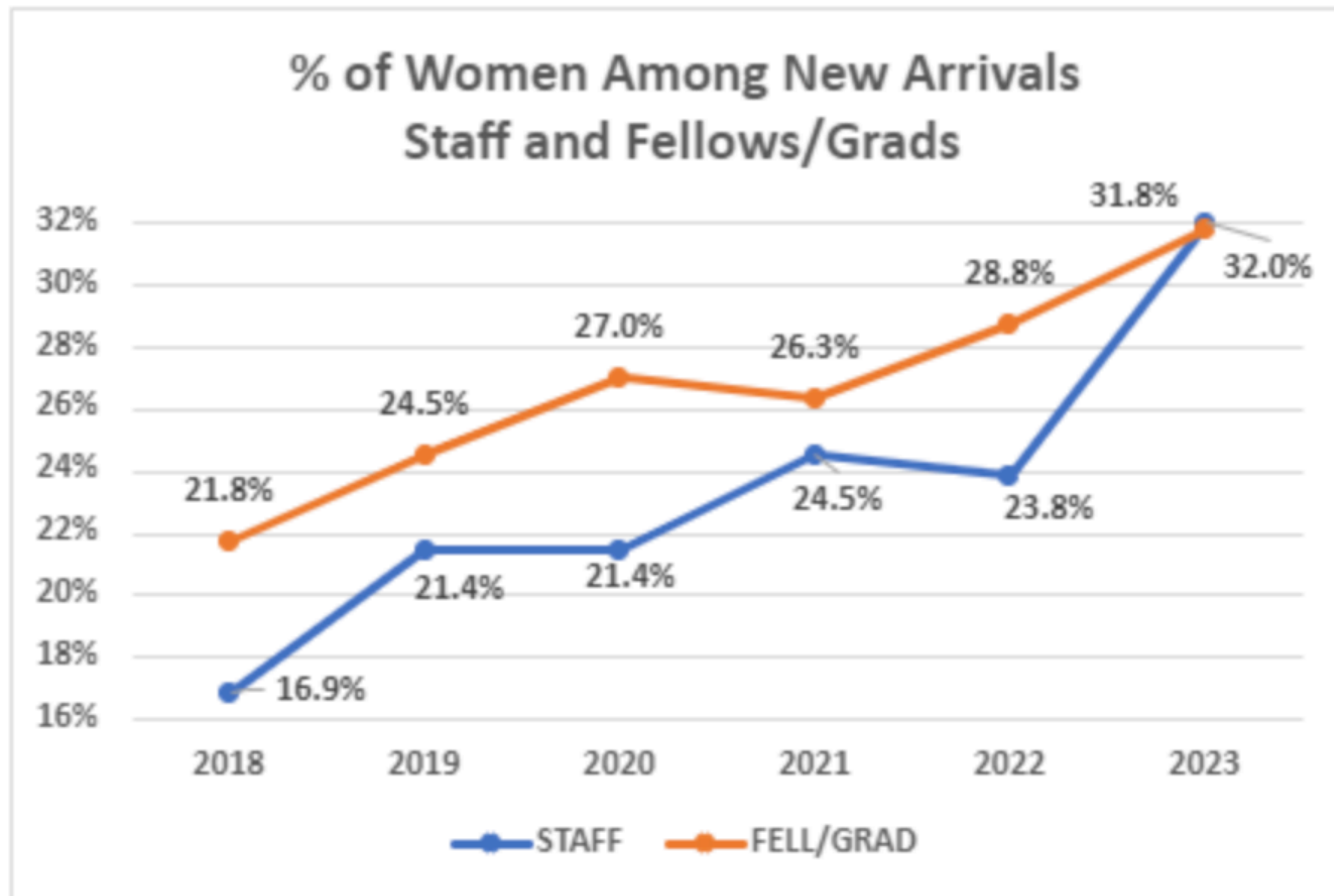


Decreasing # of members

# CERN 25 by 25

## Where we stand

Link: <https://diversity-and-inclusion.web.cern.ch/actions/25-25>





# Well-being Focus

## LHCb & ALICE



LHCb-PUB-2021-004  
May 11, 2021

### Results of the survey on the effects of the Covid-19 pandemic on LHCb scientists

E. Ben Haim<sup>1</sup>, M. F. Cicala<sup>2</sup>, F. Dordei<sup>3</sup>, S. Klaver<sup>4</sup>, R. Kocpcna<sup>5</sup>, V. Lukashenko<sup>4</sup>, N. Skidmore<sup>6</sup>

<sup>1</sup>LPNHE, Sorbonne Université, Université de Paris, CNRS/IN2P3, Paris, France

<sup>2</sup>Department of Physics, University of Warwick, Coventry, United Kingdom

<sup>3</sup>INFN Sezione di Cagliari, Monserrato, Italy

<sup>4</sup>Nikhef, Amsterdam, the Netherlands

<sup>5</sup>Heidelberg University, Heidelberg, Germany

<sup>6</sup>University of Manchester, Manchester, UK

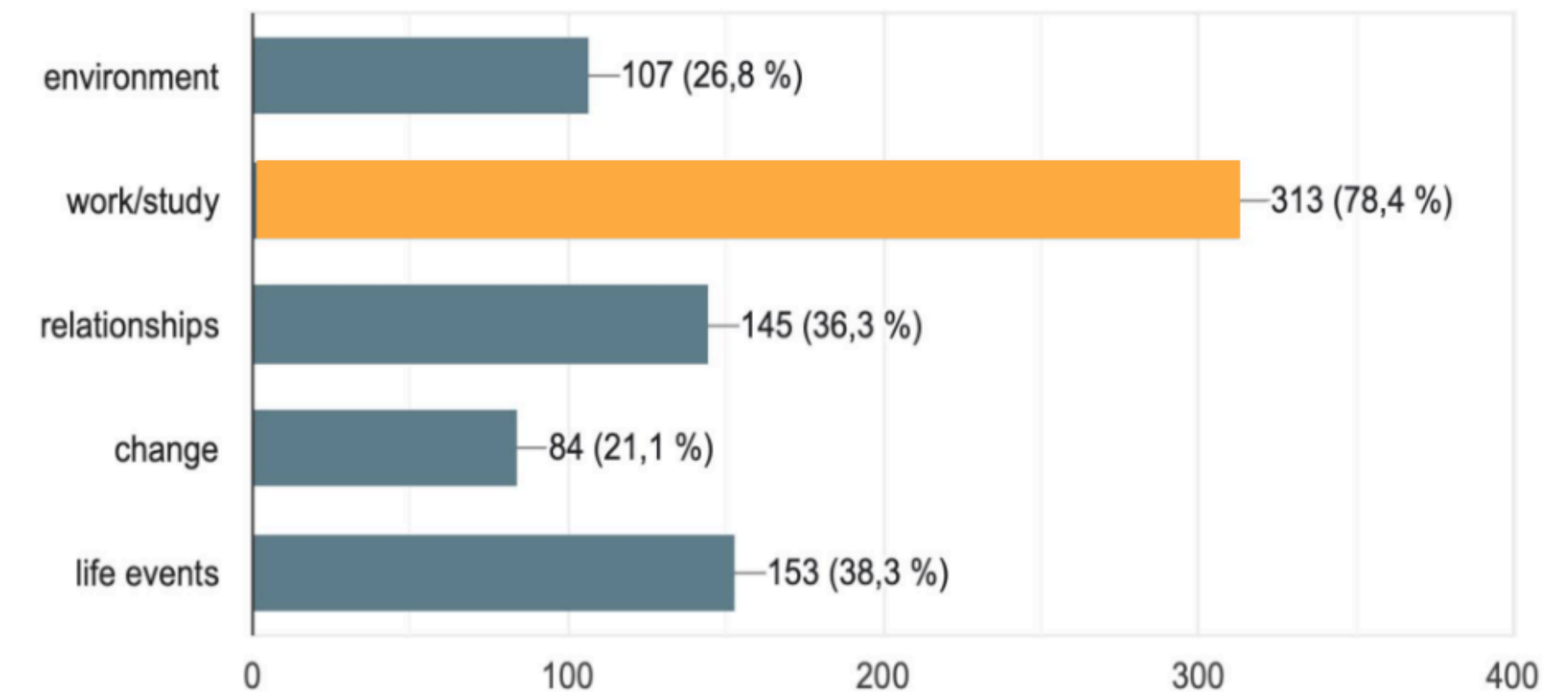
#### Abstract

In this note, we report the outcomes of a survey of LHCb scientists carried out during December 2020 regarding the social response to the Covid-19 pandemic. The survey was completed by 199 people, corresponding to about 14% of the collaboration. Amongst the most alarming issues, it was found that in particular the well-being of our younger colleagues, namely graduate students and especially post-docs, has deteriorated. This is indicated by their lack of productivity, motivation, focus and a big decline in their mental health since the beginning of the crisis. In view of these worrying results, we provide a series of suggestions hoping that this report can help to increase the awareness about less debated effects of the Covid-19 pandemic, in particular on our younger colleagues.

[Link to paper](#)

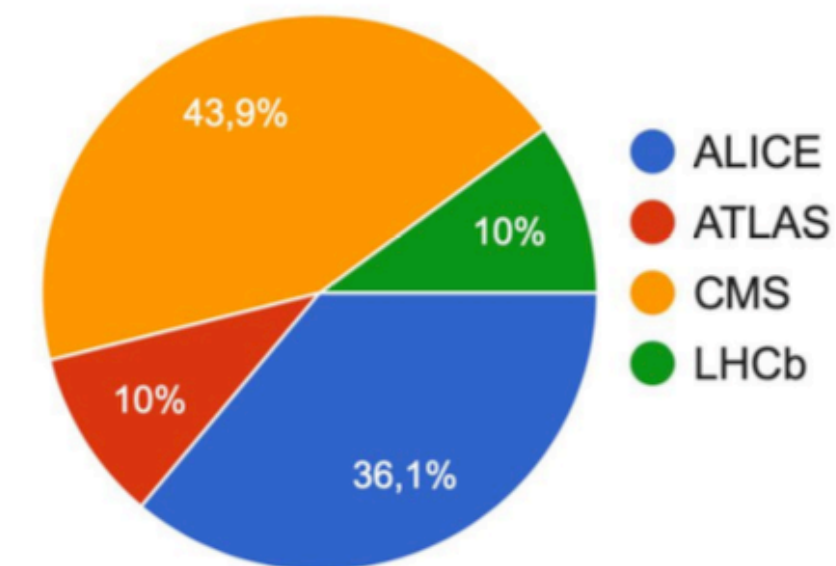
LHCb-PUB-2021-004  
19/02/2021

### What are your main stress triggers ?



*ALICE week (Oct'23) Junior's Talk*

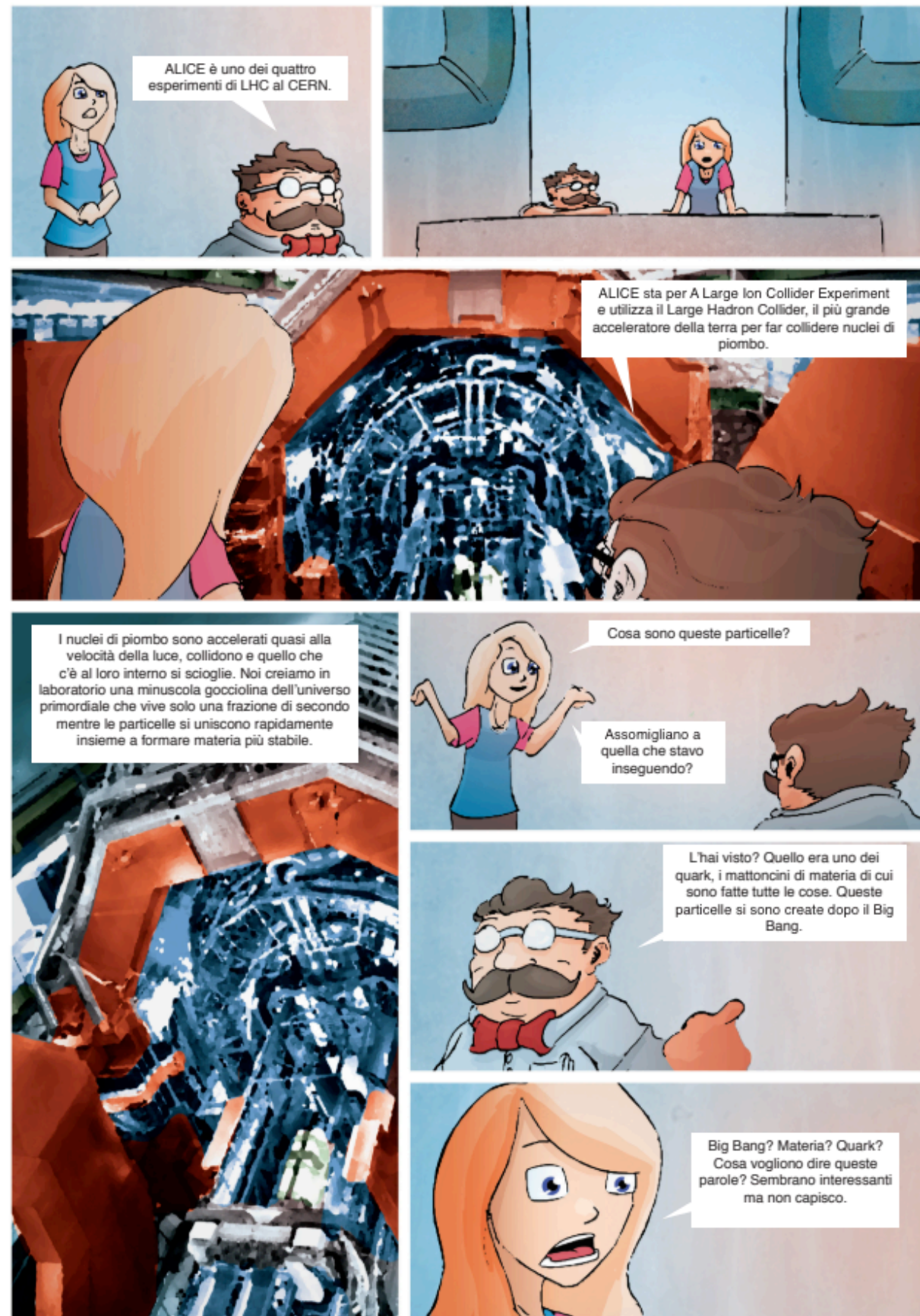
### Participation from all experiments



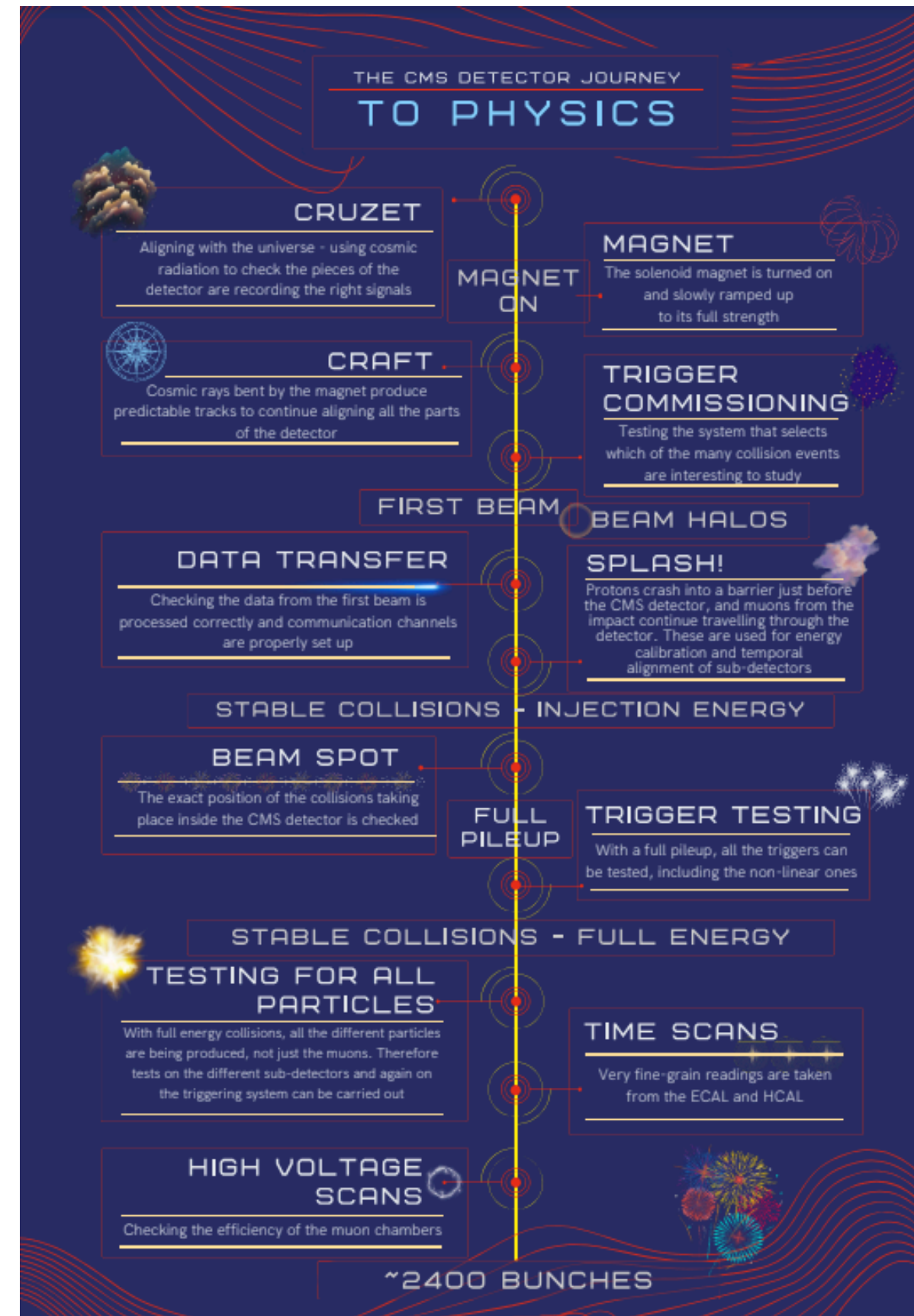
*ALICE week (Oct'23) Junior's Talk*

# Education & Outreach

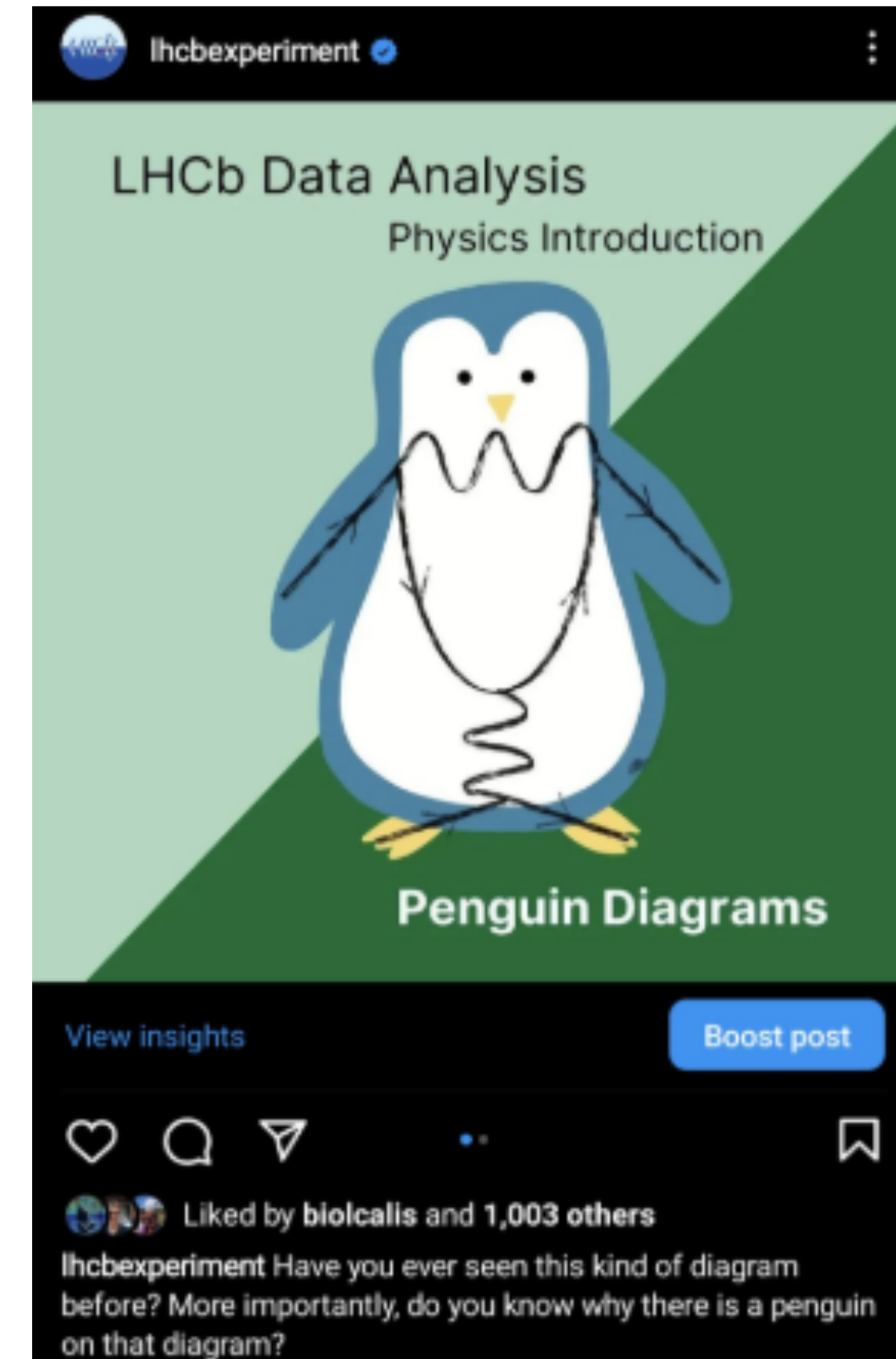
## All experiments



ALICE brochure



CMS brochure

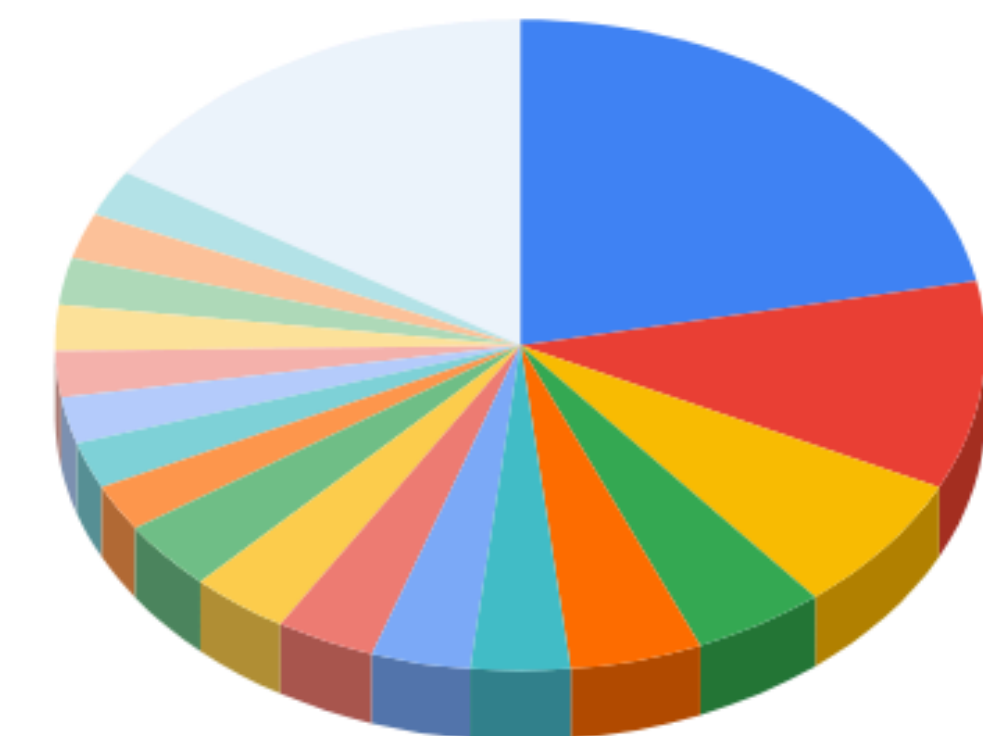


# A little bit on Outreach

## Past and present

• Outreach is essential to communicate our scientific endeavors to the general public & to create a more diverse scientific community.

• **Virtual visits:** offering the world a glimpse into research conducted at ATLAS.



*ATLAS Virtual Visits: Bringing the World To our Detector*

- Outreach efforts are wide and varied!
- **Educational material:** books, fact sheets etc. for all levels, in **various languages.**

**SELEZIONE E ACQUISIZIONE DEI DATI**

ATLAS produce fino a 1,7 miliardi di collisioni al secondo, ma non tutti questi eventi meritano di essere analizzati. I processi di selezione e acquisizione dei dati significativi servono a garantire la registrazione degli eventi di collisione più interessanti, destinati ad essere studiati in dettaglio successivamente.

I miliardi di collisioni di ATLAS equivalgono a un volume di dati pari a 60 milioni di megabyte (MB) ovvero 60 terabyte (TB) al secondo, equivalenti alla trasmissione simultanea di 5.400 video in 4K. Tuttavia solo alcuni di questi eventi presentano caratteristiche interessanti, che potrebbero portare a nuove scoperte. Per ridurre il flusso dei dati a livelli gestibili, ATLAS usa un sistema di selezione degli eventi - detto "trigger" - che sceglie gli eventi con particolari caratteristiche, per farne poi un'analisi dettagliata.

Il sistema di trigger di ATLAS esegue la selezione degli eventi in due passaggi. Il primo livello di trigger, hardware, si basa su moduli elettronici appositamente progettati e costruiti, situati sul rivelatore. Esso utilizza informazioni provenienti dai calorimetri e dallo spettrometro dei muoni. La decisione di salvare i dati di un evento viene presa in meno di 2,5 microsecondi dall'istante in cui si è formato tale evento. Durante questo intervallo, i dati dell'evento sono temporaneamente mantenuti in memoria tampone (storage buffers). Se l'evento supera la selezione, passa al trigger di secondo livello, che può accettare fino a 100.000 eventi al secondo.

Il trigger di secondo livello, software, utilizza una batteria di computer formata da circa 40.000 CPU. Per decidere quali eventi salvare si conducono, in 200 microsecondi, analisi mirate di ciascuna collisione, esaminando dati provenienti da specifiche regioni del rivelatore. Circa 1.000 eventi al secondo superano questa seconda selezione, e vengono inviati a delle banche dati per essere successivamente analizzati in dettaglio.

<https://atlas.cern>

\*All LHC experiments have active outreach efforts