

Diversity and Inclusion in the CMS experiment.

Hugo Alberto Becerril Gonzalez^{a,*}

^a*Deutsches Elektronen-Synchrotron (DESY),
Notkestraße 85, Hamburg, Germany*

E-mail: hugo.alberto.becerril.gonzalez@cern.ch

The CMS experiment is one of the largest international scientific collaborations in history, involving more than 6000 particle physicists, engineers, technicians, students and support staff from 257 institutes in 59 countries, therefore, the CMS collaboration is inherently a diverse and unique scientific environment. In this report we present statistical information related to diversity in CMS with data collected between 2016-2018. The purpose of this analysis is not to draw conclusions but to raise awareness among the general population and influence future decisions.

*The European Physical Society Conference on High Energy Physics (EPS-HEP2023)
21-25 August 2023
Hamburg, Germany*

*Speaker

1. Introduction

1.1 The CMS collaboration

CMS is one of the four major particle detectors at CERN's Large Hadron Collider (LHC) [1]. Its name stands for Compact Muon Solenoid: Compact because, compared to other detectors, it is small for all the detector material it contains, Muon for one of the particles that are produced in proton-proton collisions and that can be identified and reconstructed with high precision and Solenoid for the coil that forms the very intense superconducting magnet. The CMS Collaboration assembles more than 6000 people including scientists, engineers, computer experts, and students from around 240 institutions and universities across more than 50 countries in a joint endeavor to push the boundaries of our comprehension of the fundamental laws governing our Universe.

1.2 The Diversity & Inclusion Office at CMS

The objective of a CMS Diversity & Inclusion Office is to cultivate a workplace environment in which all Collaboration members can excel and contribute their skills, regardless of factors such as age, career stage, employment status, institutional affiliation, geographic location, nationality, gender, ethnicity, family status, sexual orientation, or disabilities. The mandate of the Diversity & Inclusion Office is to:

- Advise management and individuals on diversity related matters.
- Propose actions to promote diversity and create awareness.
- Monitor and record statistical information related to diversity.
- Actively listen to Collaboration members' concerns.
- Report regularly to the Collaboration about status and progress of diversity-related issues.
- Collaborate with relevant bodies outside CMS such as the CERN Diversity & Inclusion Programme if required.

The office collaborates with many internal groups to give ideas and create content for people inside and outside the collaboration, for example:

- The international Day of Woman and Girls in science: <https://cylindricalonion.web.cern.ch/blogs/cms-women-science>.
- "Exploring diversity & Inclusion" booklet: <https://heyzine.com/flip-book/00f6546b1c.html>

2. Analysis

2.1 Purpose of the analysis

CMS collects data on a variety of variables for all its members (gender, career level, institute, etc.). The CMS database is generated from the centralized CERN database, which in turn is based on registration forms verified against government-issued documents (i.e., passport). The purpose of the following analysis is:

- Present the collected data in a format that is easily understandable and accessible to the entire collaboration.
- Generate and assess diversity metrics relevant to CMS and provide recommendations for its improvement.
- Contribute to studies focusing on gender demographics in the sciences. Contribute to studies focusing on regional demographics in the sciences

2.2 Gender Distribution at CMS

CERN database is only Passport Gender (Male/Female). Individuals can explicitly ask to not be classified in the CMS database, which should not be interpreted as a non-binary gender marker. The total number of members/authors and the total number of female members/authors between 2016 and 2022 is shown in Fig 1. As it can be observed, the fraction of female members has consistently increased from 18.5% to 21.5% (+3%), and authors from 17.3% to 19.8% (+2.5%) since 2016.

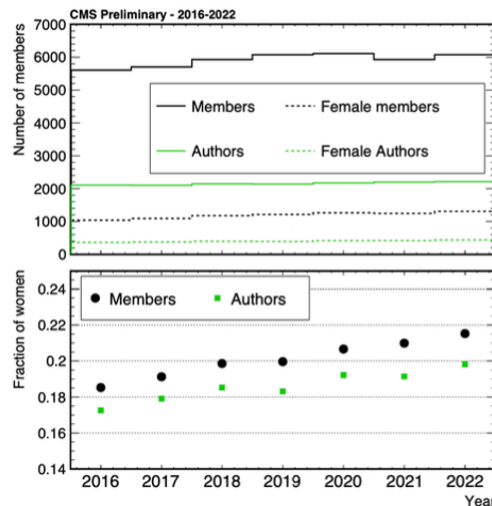


Figure 1: CMS gender distribution between 2016-2022. The ratio shown the fraction of female members (black) and female authors (green) across the years.

2.3 Gender distribution at CMS by professional activity

The professional categories considered by CMS are Non-Doctoral Student, Doctoral Student, Engineer, Physicist (Experimental, Theorist), Technician and Administrative. The average total number of members and total number of female members is shown in Fig 2. Non-doctoral and doctoral categories exceed the average, but the ratio drops to 18% for physicists. Administrative is the only professional category with more women than men.

2.4 Gender distribution at CMS by region/institute category

Regions in CMS are classified as:

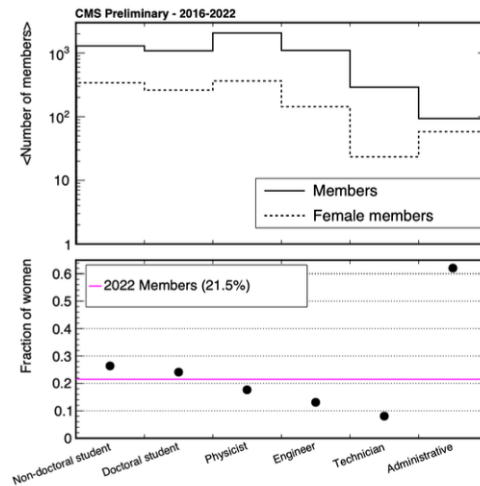


Figure 2: Average number of total members and total female members in the CMS experiment between 2016-2022 for different professional activities. The ratio plot shows the ratio shown the fraction of female members.

- CERN
- France (FR)
- Italy (IT)
- Germany (DE)
- Switzerland (CH)
- United Kingdom (UK)
- Other CERN member states (OCMS) Russia and Dubna member states (RDMS)
- United States (USA)
- Other states A (CN, IN, MY, NZ, PK, LK, IR, TW, TH)
- Other states B (BH, BR, CL, CO, HR, CY, EC, EE, IE, KW, LV, LB, LT, MX, OM, EG, ME, QA, SA, TR, UA)

On average, European institutes below the average while African and Asian institutes with the largest percentage of women as members, 28% and 26% respectively. In terms of institutes Russia, USA, CERN and UK have the largest difference between female members and female authors. Some institutes employ a significant number of engineers, technicians, and administrative staff who are not included in the author list.

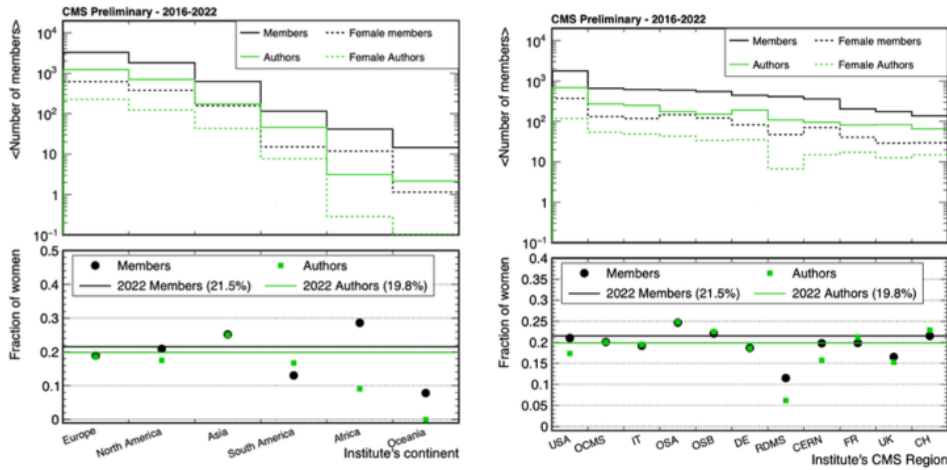


Figure 3: Average number of total members and total female members in the CMS experiment between 2016-2022 per continent and region (as defined by CMS). The ratio plot shows the ratio shown the fraction of female members (solid line) and female authors (dots).

2.5 Institute Continent per year

The evolution of the number of members and authors over the years as a function of their home institutions, grouped by continents is shown in Fig 5. Among the continents with major participation in CMS, there is an increase of the number of members and authors of the fraction of women in the collaboration throughout the years.

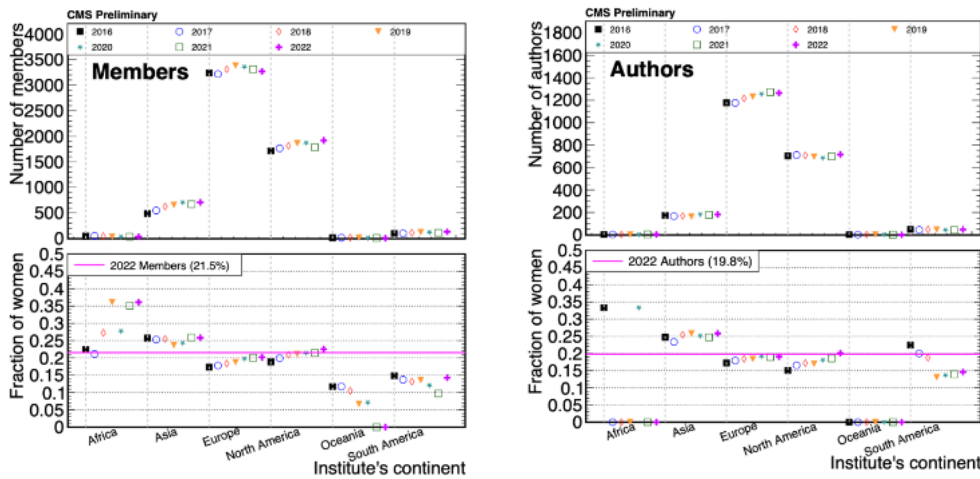


Figure 4: Number of members (left) and authors (right) in the CMS experiment from 2016 to 2022 per continent. The ratio plot shows the fraction of female members and authors per continent per year.

2.6 Age distribution between 2016-2022

Normalized number of members and authors per year and fraction of women per year. Nearly half of the total members and authors are younger than 35 mostly students and people in term-limited

contracts. Female ratio decreases w.r.t. age. Positive trend in most of the bins between 2016 and 2022. Significantly visible for the authorship for age < 30–34.

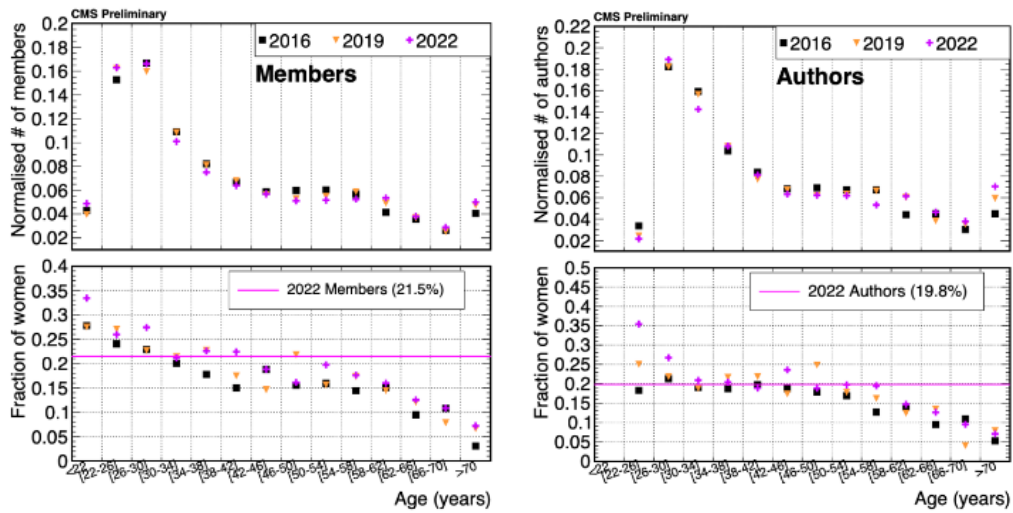


Figure 5: Number of members (left) and authors (right) in the CMS experiment from 2016 to 2022 per age range. The ratio plot shows the fraction of female members and authors

References

- [1] CMS Collaboration, The CMS experiment at the CERN LHC, 2008, JINST, 3S08004