Wasted talent: the status quo of women in physics in the US and UK

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QMUL

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International Women Day's QMUL Faculty Event
@School of Physical and Chemical Sciences

https://en.wikipedia.org/w/index.php?title=Timeline_of_women_in_science

1200 BCE: The Mesopotamian perfume-maker Tapputi-Belatekallim often considered the world's first recorded chemist.

1572: Danish scientist Sophia Brahe (1556–1643) assisted her brother Tycho Brahe with his astronomical observations

1732: Italian physicist Laura Bassi became the first female physics professor in the world

1843: English mathematician and computer programmer Ada Lovelace

1918: German physicist and mathematician Emmy Noether created Noether's theorem explaining the connection between symmetry and conservation laws.

1888: American chemist Josephine Silone Yates was the first black woman to head a college science department.

1950: Chinese-American particle physicist Chien-Shiung Wu

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Margherita Hack was an Italian astrophysicist and science communicator.

Wasted talent:

From paper:

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https://doi.org/10.1038/s42005-024-01579-9

Wasted talent...

Women+ continue to face obstacles at each step along the way of pursuing a scientific career, and physics has one of the lowest gender diverse participation of all STEM subjects.

This is a tremendous waste of potential that can only be reversed with a significant cultural change by all participants.

Wasted talent...

At present, only 24–25% of physics degree recipients in the UK/US identify as women+.

US saw no improvement since 2005 and physics, along with computer science and engineering, has the lowest participation ratio of women+.

Wasted talent...

In the UK the percentage of women physics undergraduates has only increased by 3% points from 2012/13 to 2017/18, and a high proportion of this growth has been driven by foreign women choosing to study physics in UK universities.

In biology and chemistry respectively, 60% and 50% of the degrees are obtained by women, and these percentages have been steadily increasing since the 1970s.

Wasted talent...

The stereotype is that girls do not *or should not* like mathematics. Hence, girls can find it harder to identify themselves with physics professions.

The Institute of Physics (IoP) has been running the Limit Less Campaign since 2020.

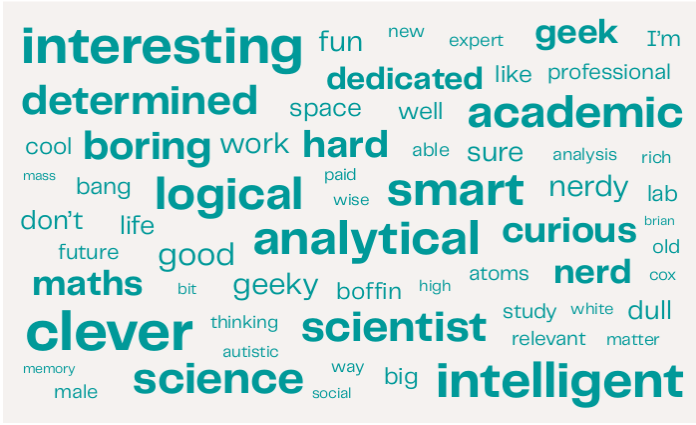
This campaign is not directly aimed at young people themselves. Instead, it is aimed at those whom younger people trust and listen to, and who help shape their opinions and decisions.

https://www.iop.org/sites/default/files/2020-11/IOP-Limit-Less-report-2020-Nov.pdf

IoP Limit Less Campaign

"My dad told me not to study physics because it wasn't for women and the maths was too hard"

"A Black girl studying and being good at physics wasn't the stereotype my teachers were used to. I'm very sure the bias they had towards me was unconscious, as they were really nice people, and in fact, good teachers (to the other, whiter, students)."



"For individuals who lack social skills … a bit geeky … for duller people"

Parents in focus group discussions

England

In 2020,

only 2.6% (7,147) of girls chose A-level physics, compared to

8.6% (24,685) of boys.

(Source: Joint Council for Qualifications)

Women account for 50% of all apprentices in the UK.

However, for science, technology, engineering and maths (STEM) apprenticeships, in the 2018–19 academic year, only 10% of STEM apprenticeships were started by women.

Wasted talent...

Focus on creating committees to raise awareness of the limited recognition of women physicists.

These policies enhanced outreach opportunities with women serving as role models, improved recognition of women physicists and provided initial networking opportunities at meetings.

The committees, however, did not address implicit bias and active structural gender discrimination.

Wasted talent...

From IoP investigation, issues are lack of recruitment, retention, and progression of women+.

Project Juno was created: an equality, diversity, and inclusion (EDI) award framework to encourage physics university departments to follow, evidence and champion good practices

Over 44 UK universities were engaged in Project Juno.

Replaced with the Physics Inclusion Award in April 2024 to support university physics departments to be welcoming and inclusive to all. https://www.iop.org/about/IOP-diversity-inclusion

Project Juno

IOP gender equality awards for physics in the UK and Ireland

Project Juno is an awards scheme managed by the Institute of Physics. The scheme recognises and rewards physics departments, institutes and groups that can demonstrate they have taken action to address the under-representation of women at all levels, and are encouraging better working practices for all.

1. A robust organisational framework to deliver equality of opportunity and reward.
2. Appointment and selection processes and procedures that encourage men and women to apply for academic posts at all levels.
3. Departmental structures and systems which support and encourage the career progression and promotion of all staff and enable men and women to progress and continue in their careers.
4. Departmental organisation, structure, management arrangements and culture that are open, inclusive and transparent and encourage the participation of all staff.
5. Flexible approaches and provisions that enable individuals, at all career and life stages, to optimise their contribution to their department, institution and to SET.

Project Juno gave support and guidelines and stimulate actions within the schools.

Juno committees involved staff and students at all levels and include also head of school/management figures. Promoted awareness within the schools.

Lots of concrete actions started thanks to this project.

I presented this to the main 2016 physics conference in the EDI session

Wasted talent...

In 2006 the APS started yearly regional CUWiP (Conference for Undergraduate Women+ in Physics) conferences:
students are exposed to top research by leading women+ physicists, they engage on topics related to being a minority, they participate in professional development opportunities, and they build their first network of peers.

In 2015 Professor Daniela Bortoletto introduced CUWiP+ to the UK, which is now supported by the IoP.

Other one-day events hosted by various universities and aimed at women+ postgraduate students have since been established (e.g. KCL Womxn in Physics).

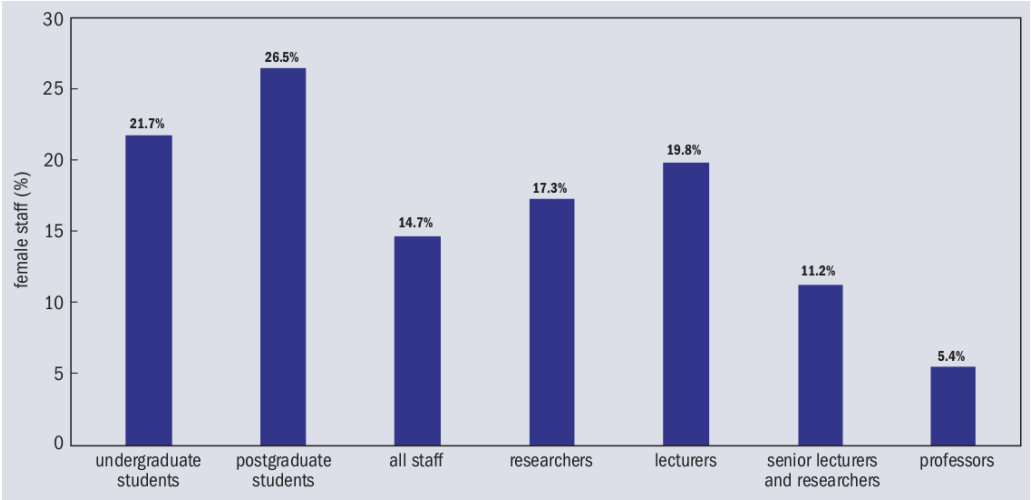
Wasted talent...

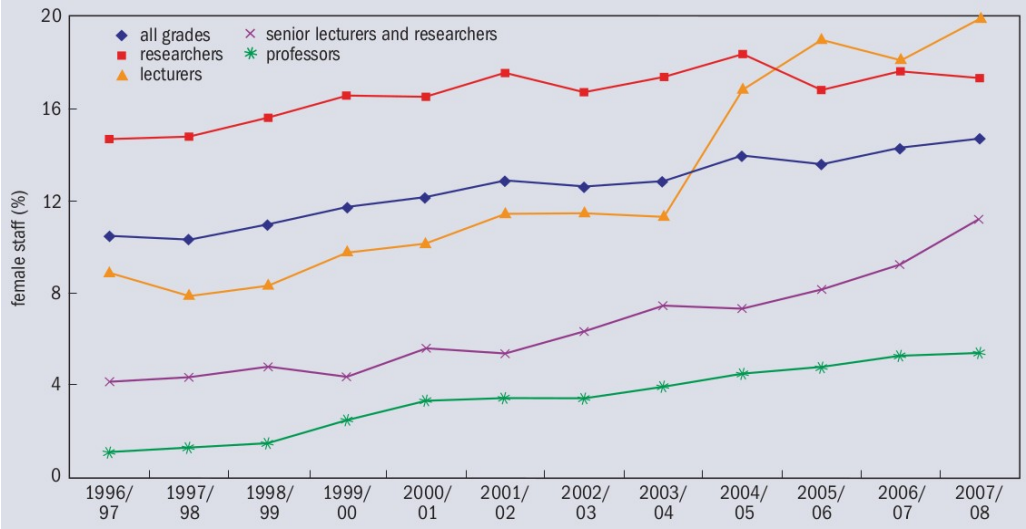
In the UK, only 12% of professorships are held by women while this increases to 26% for all other subjects combined.

In the US, 19% of the physics faculty are women, however most women are in non-tenure eligible teaching-only positions, and when we only consider PhD granting institutions, the average drops to 16%.

The percentage of women drops with prestige and seniority at each level, and exacerbates the initial societal bias at all career stages.

Diversity in University Physics Statistical Digest 2010





According to Eurostat data, in 2020 in Europe, 41% of people in STEM are women.

The percentage has only slightly increased with respect to 2011 when it was 39%.

Wasted talent...

These statistics clearly showcase the amount of pressure on women+ academic staff in providing that important exemplary “role model” to younger generations, and serves as a reminder that increased outreach to counter societal and cultural bias is not enough.

Wasted talent...

An encouraging example comes from the astronomy community in the USA, which has been a field-leading this paradigm change.

The 1992 Baltimore Charter for Women in Astronomy is a manifesto for women acknowledgement and promotion in the astronomy community, and its recommendations were adopted by various departments.

The Baltimore Charter for women in astronomy
https://www.stsci.edu/stsci/meetings/WiA/BaltoCharter.html (1992).

Wasted talent...

The Charter includes affordable childcare, parental leave, extension of the tenure-clock and publishing codes of conduct.

Prizes and fellowships started to allow self-nominations.

Over the past 30 years, all these changes combined led to a doubling of women percentages at the full professor rank, in prize winners, in prestigious leadership positions and post-doc fellowships.

Wasted talent...

Women+’s scientific achievements do not receive the same recognition as men, and this bias affects all aspects of a scientific career: from access to academic positions to the publishing world.

The visibility of women+ in the academic and public sphere is significantly less than that of men, with a lower rate of women+ promotion over that of men, by being under-represented as plenary speakers, contributing to panels, and as prize winners. Several studies show that women+ are cited at lower rates.

Wasted talent...

This persistent under-recognition of women+'s contributions is the leading cause for senior women+ to leave academia at a higher rate than early career women+.

These data indicate a two-fold failure of the physics community: not only does it fail at attracting young women+, but it is also willing to forfeit the scientific expertise matured over years of invested commitment to science.

Wasted talent...

NASA has introduced a double-anonymous review for observational time on all their telescopes. The double-anonymous review improved the acceptance rate for women+ compared to previous years, making it similar to that of men.

Allowing for self-nominations, improving transparency in selection processes and criteria can reduce unconscious bias in nominations and selection of candidates and proposals.

Wasted talent...

As major physics discoveries face increasingly ambitious problems, it is time to get rid of the old-fashioned “lone (male) genius myth”, and start tapping into the rich pool of talented women+.

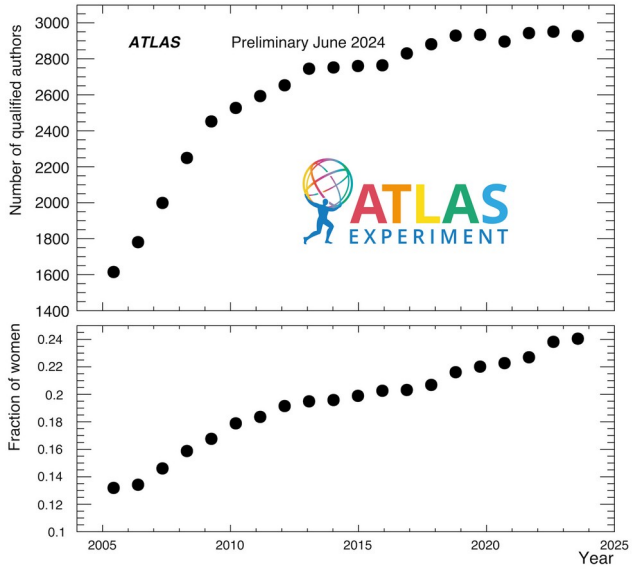
For this cultural shift to occur, awareness and active change must be supported not only by women, but importantly by the man-dominated physics leadership in individual departments, universities, and physical societies. It is well proven that committed leadership can have significant effects in enacting change.

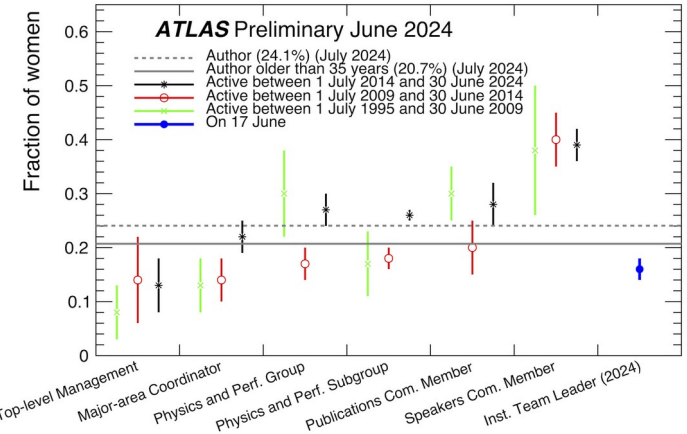
Wasted talent...

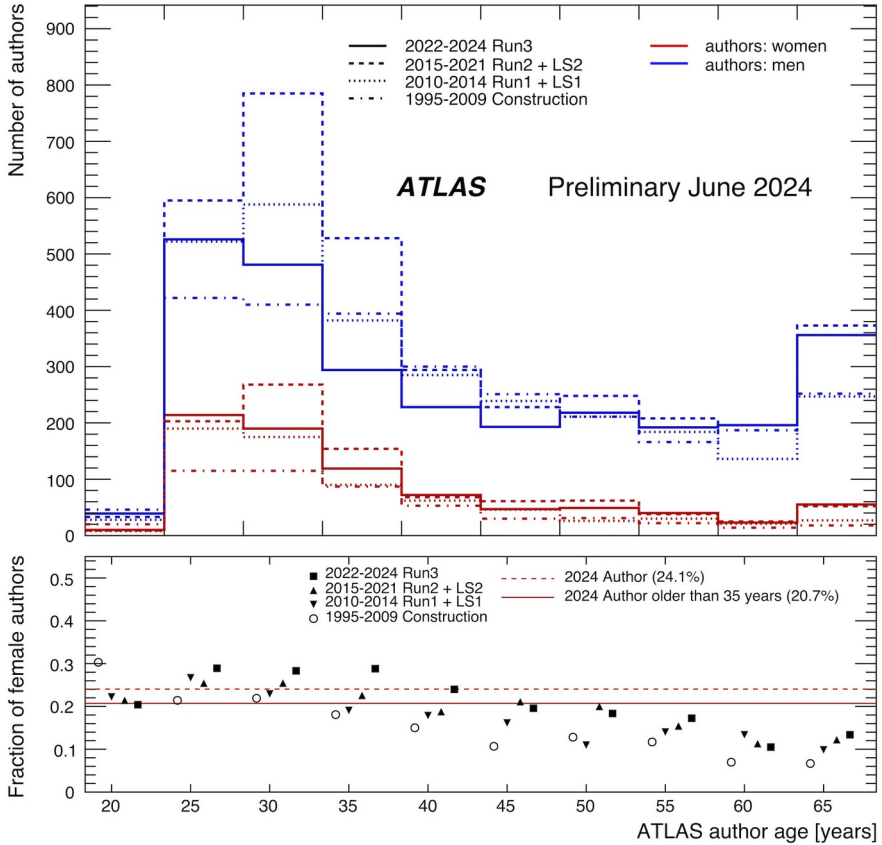
Acknowledging that gender diversity in physics has made little progress in the US/UK in the last 20 years, that an enormous number of skilful early careers and experienced women+ physicists have been lost and that passive waiting for new generations and minorities to lead the change is insufficient

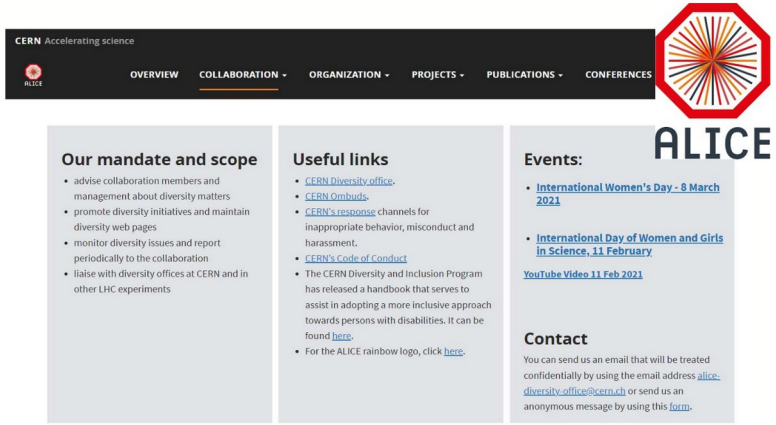
Experiment	ALICE	ATLAS EXPERIMENT	CMS	LHCb
Countries Involved	39	40	54	19
Institutions Involved	172	180	242	88
Number of Collaborators	1968	5900	5416	1482
Gender Ratio	~21 %	~21%	~20%	~19%

CERN LHC experiments monitor their collaborators

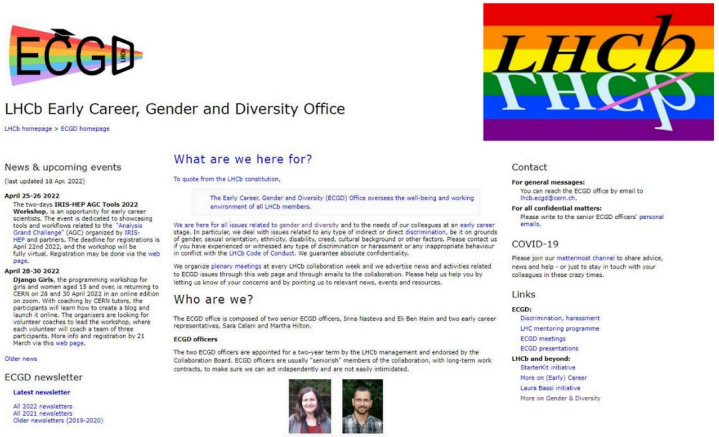

ATLAS
Preliminary June 2024
Number of qualified authors
Fraction of women
Year


ATLAS Preliminary June 2024
Author (24.1%) (July 2024)
Author older than 35 years (20.7%) (July 2024)
Active between 1 July 2014 and 30 June 2024
Active between 1 July 2009 and 30 June 2014
Active between 1 July 1995 and 30 June 2009
On 17 June
Fraction of women
Top-level Management
Major-area Coordinator
Physics and Perf. Group
Physics and Perf. Subgroup
Publications Com. Member
Speakers Com. Member
Inst. Team Leader (2024)

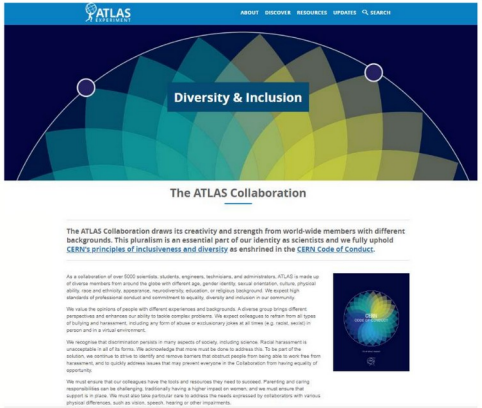

2022-2024 Run3
2015-2021 Run2 + LS2
2010-2014 Run1 + LS1
1995-2009 Construction
authors: women
authors: men
ATLAS
Preliminary June 2024
Number of authors
Fraction of female authors
2024 Author (24.1%)
2024 Author older than 35 years (20.7%)
ATLAS author age [years]



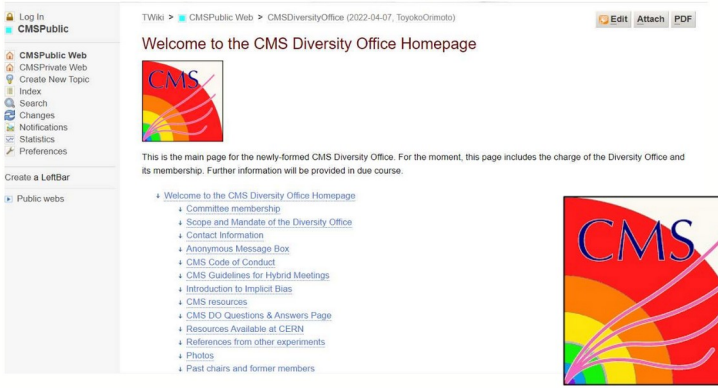
https://alice-collaboration.web.cern.ch/DiversityOffice



https://lhcb.web.cern.ch/ECGD_Office/ECGD-intro.html



https://atlas.cern/diversity



https://twiki.cern.ch/twiki/bin/view/CMSPublic/CMSDiversityOffice