



STATUS REPORT TO THE R-ECFA VISIT TO THE UK

Physics Education and Outreach in the UK

Kate Shaw

University of Sussex

Physics Education and Training

Too few young people are choosing physics-related education and training beyond the age of 16, to fuel future innovation

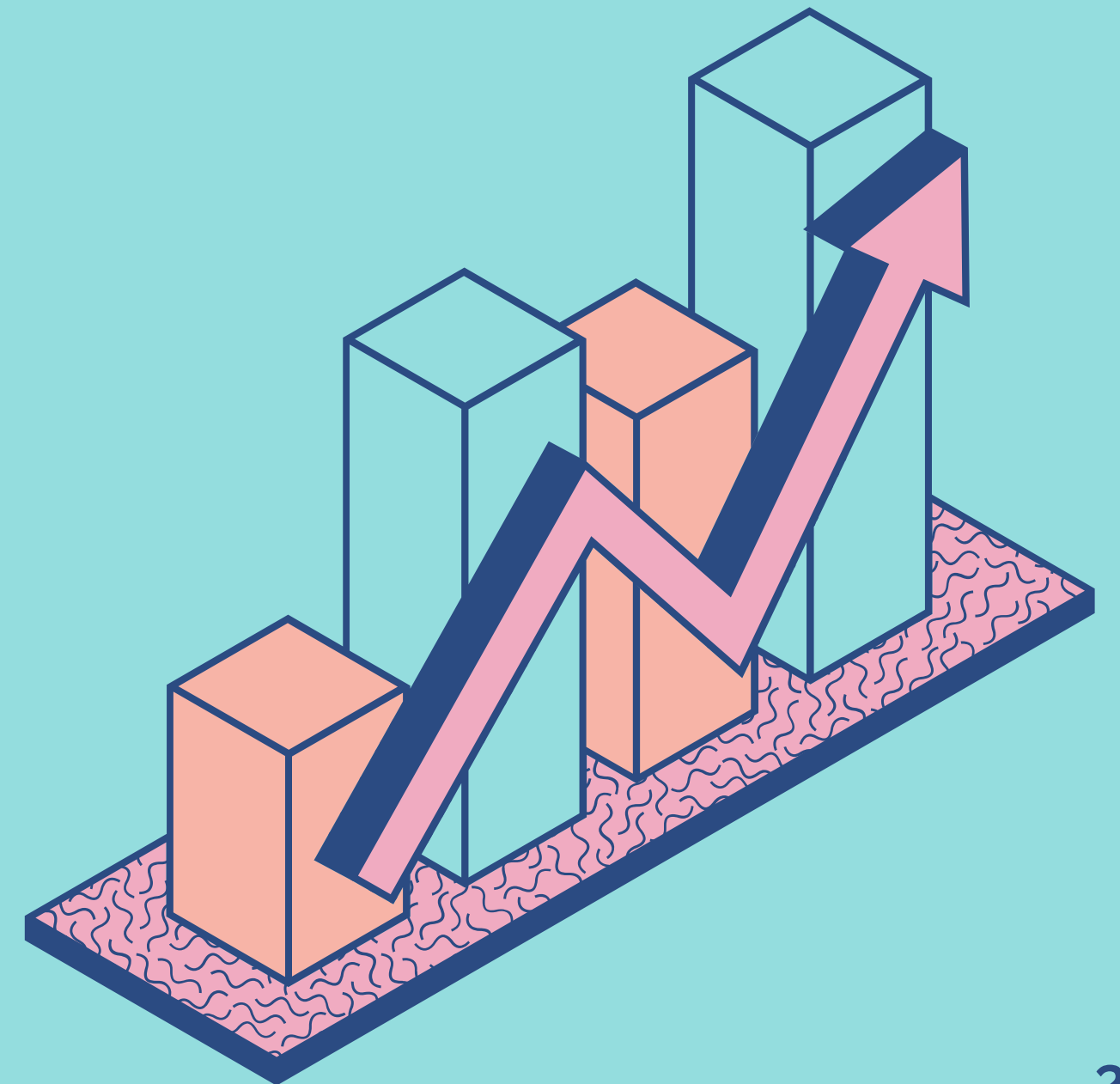
Employers are **struggling to find people** with the requisite skills among the current workforce, forcing them to **scale back planned R&D**.

There is a **lack of diversity** among those studying and working with physics, limiting opportunity and innovation outcomes.

IOP Report [1]

[Physics: investing in our future](#)

“Physics knowledge and skills are powerful drivers of productivity and innovation and open doors to a range of rewarding careers across the entire economy.”



Barriers to unlocking potential

WHAT ARE THE MOST SIGNIFICANT BARRIERS PREVENTING THE UK FROM DEVELOPING THE WORKFORCE NEEDED FOR PHYSICS R&D TO THRIVE?

“Increasing R&D investment to 2.4% of GDP by 2027 would generate an additional 80,000 jobs and £30.5bn in GDP¹.”

1. Teaching workforce challenges

There are serious shortages of teachers with a physics background in secondary and further education.

IOP Report [1]

[Physics: investing in our future](#)

2. Lack of diversity and inclusive culture

Women, people from disadvantaged backgrounds, disabled people, those who identify as LGBT+, and minority ethnic groups are all underrepresented.

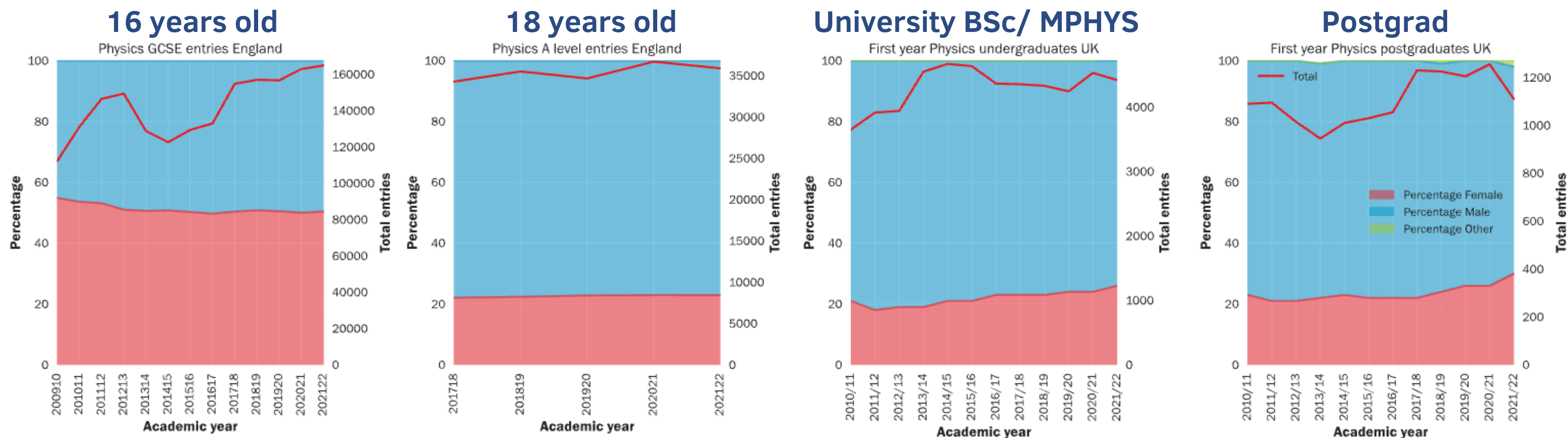
3. Inflexible research careers & interaction with industry

Research career structures are narrow with few incentives for industrial engagement, preventing people from moving easily between academia and industry.

Physics Education in Schools & Universities

PHYSICS STUDENT NUMBERS

Physics Student numbers have been on the up (until 2021/22): Gender balance has been improving at UK universities, but less in schools.





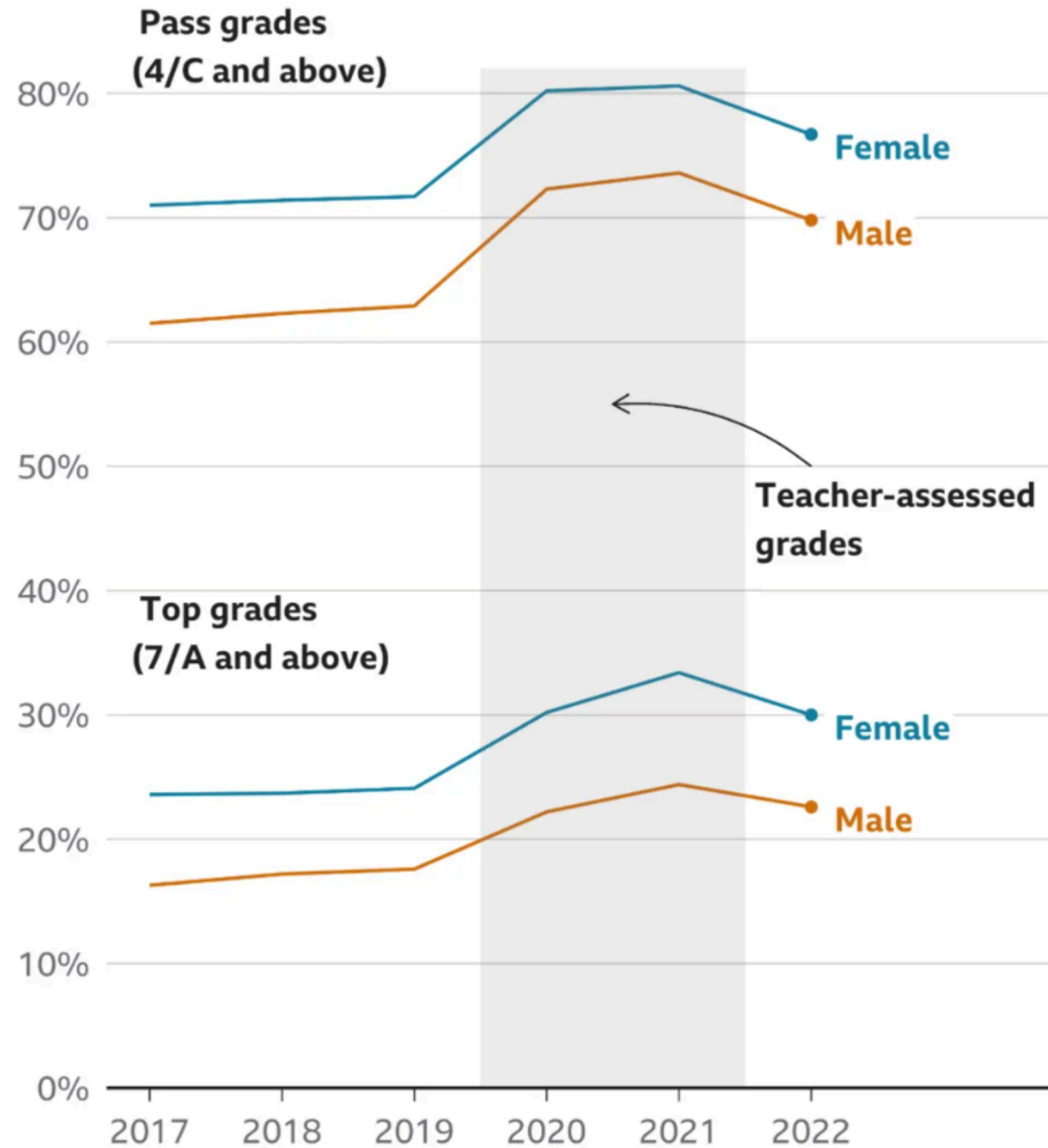
EDI ISSUES in UK PHYSICS

- Gender
- Ethnicity
- Region /Economic Background



Girls consistently outperform boys at GCSEs

Percentage of pass and top grades across all subjects by gender



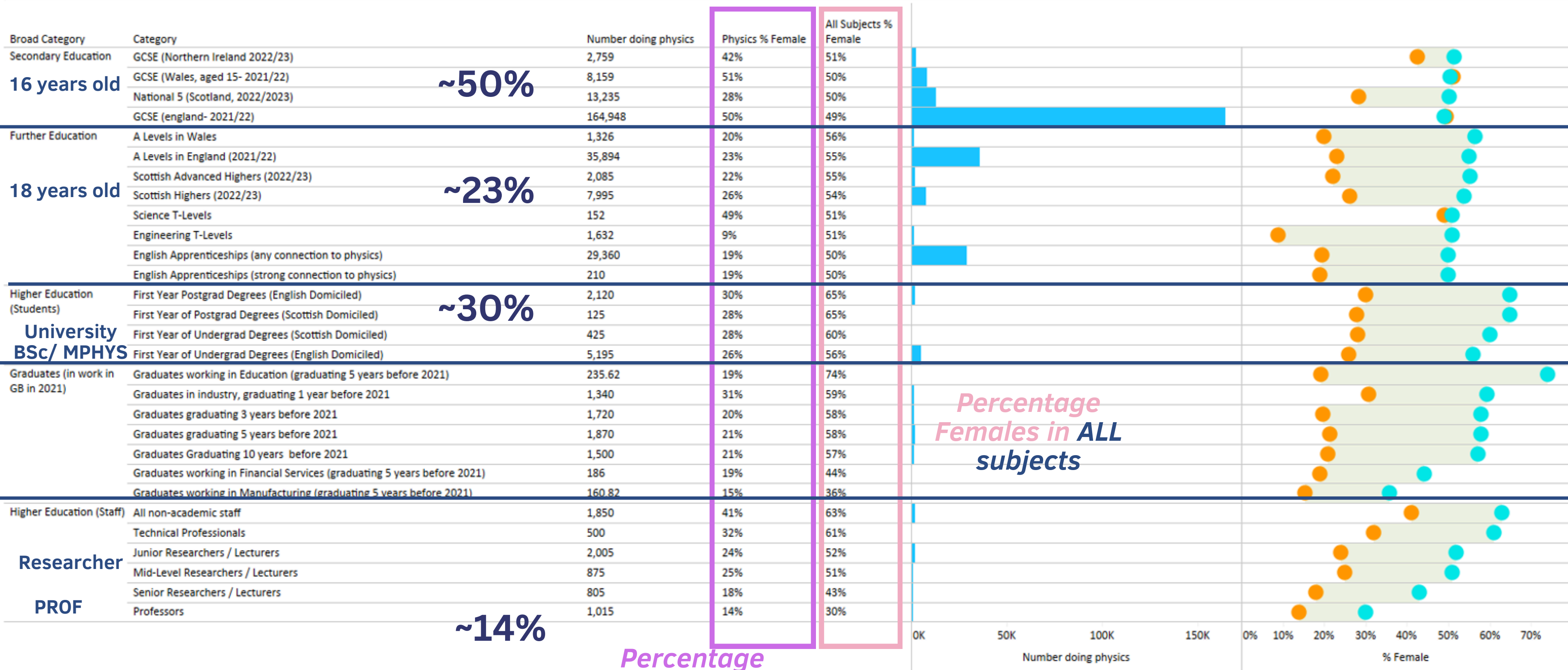
Females consistently outperform males by ~10% at GCSE (16 Year old exams)

Source: Joint Council of Qualifications



Gender & Participation: The Pipeline

Physics has an even gender split at GCSE in England & Wales. It's then very male-dominated at further education- slightly less so in higher education.



Sources:
 Department for Education (England)
 SQA (Scotland)
 CCEA (Northern Ireland)
 StatWales (Wales)
 HESA / JISC (University Data)
 IOP

Percentage Females in Physics

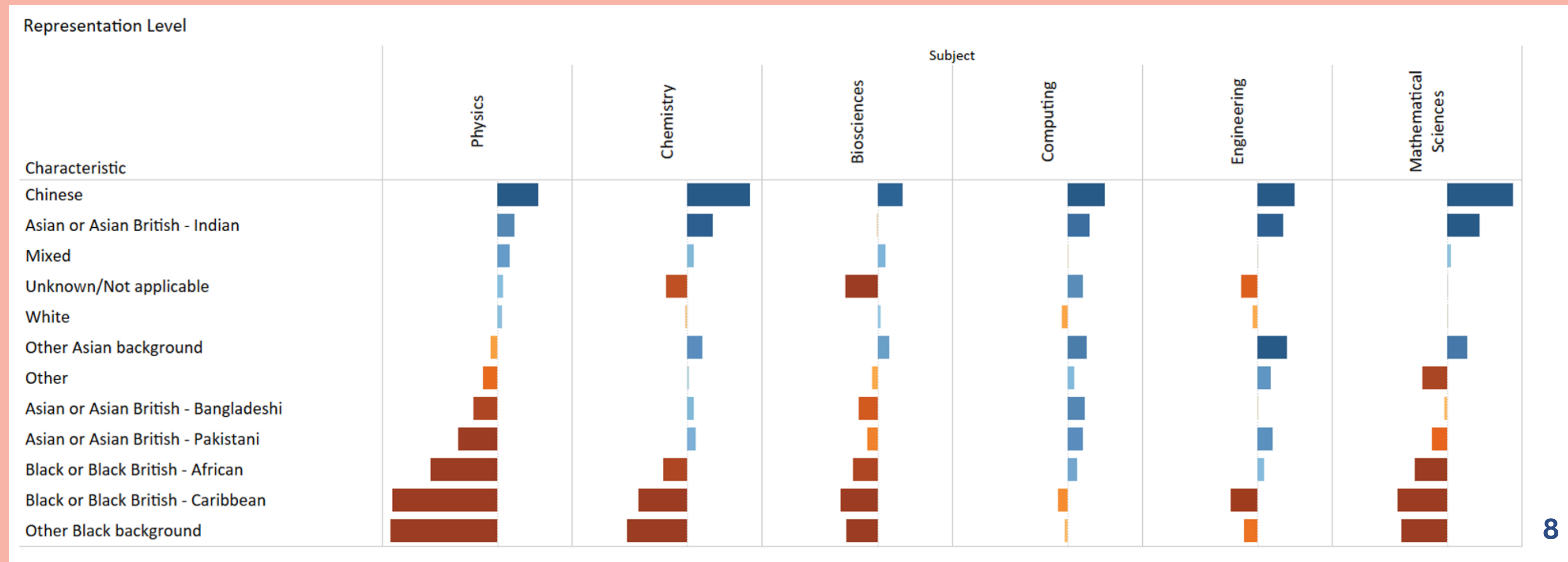
Percentage Females in ALL subjects

- Measure Names
- All Subjects % Female
 - Number doing physics
 - Physics % Female

EDI ISSUES IN PHYSICS EDUCATION

Black or Black British is the most underrepresented group in A level Physics.

UNIVERSITY PHYSICS STUDENT ETHNICITY IN PHYSICS



Students from Black and some Asian backgrounds continue to be under-represented in physics at university: More-so than in many other comparable subjects

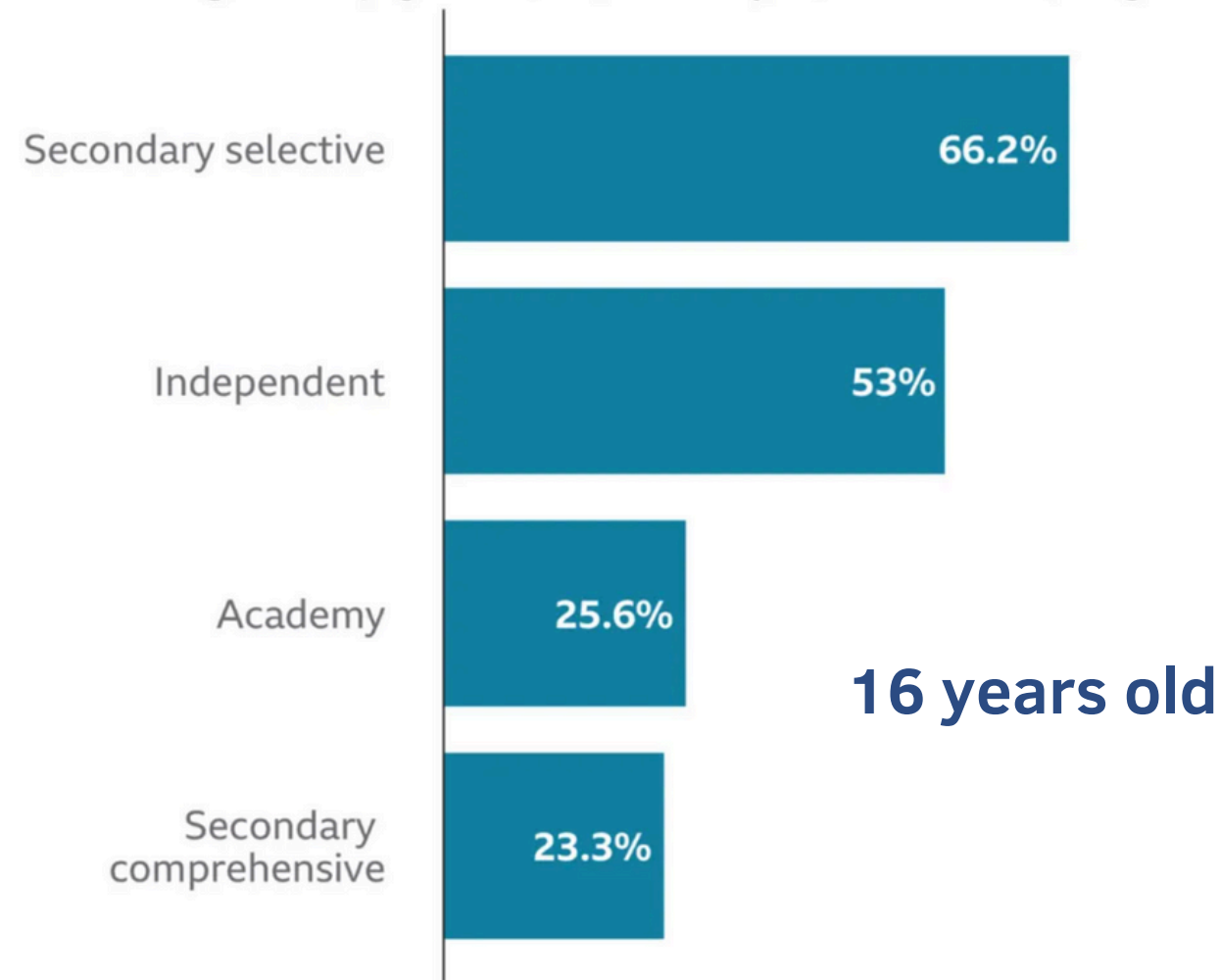
EDI issues in the UK : economic background

GCSE results: Grades show growing regional divide in England 16 years old

© 25 August 2022 · 1078 Comments

Selective and private schools in England maintain highest top GCSE grades

Percentage of top grades, 7 (formerly A) and above, England

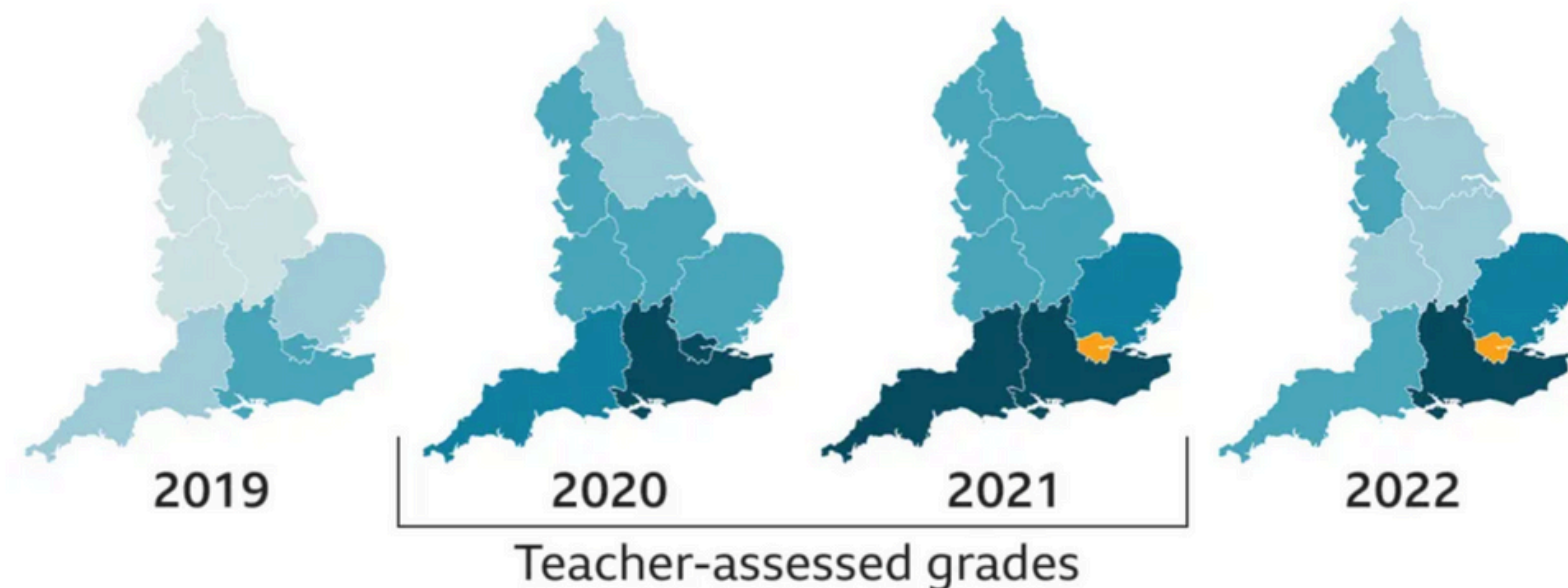
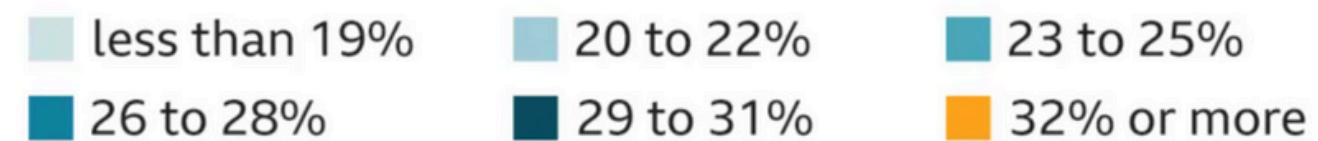


16 years old

Source: Ofqual

BBC

Percentage of top grades, 7 (formerly A) and above, by region



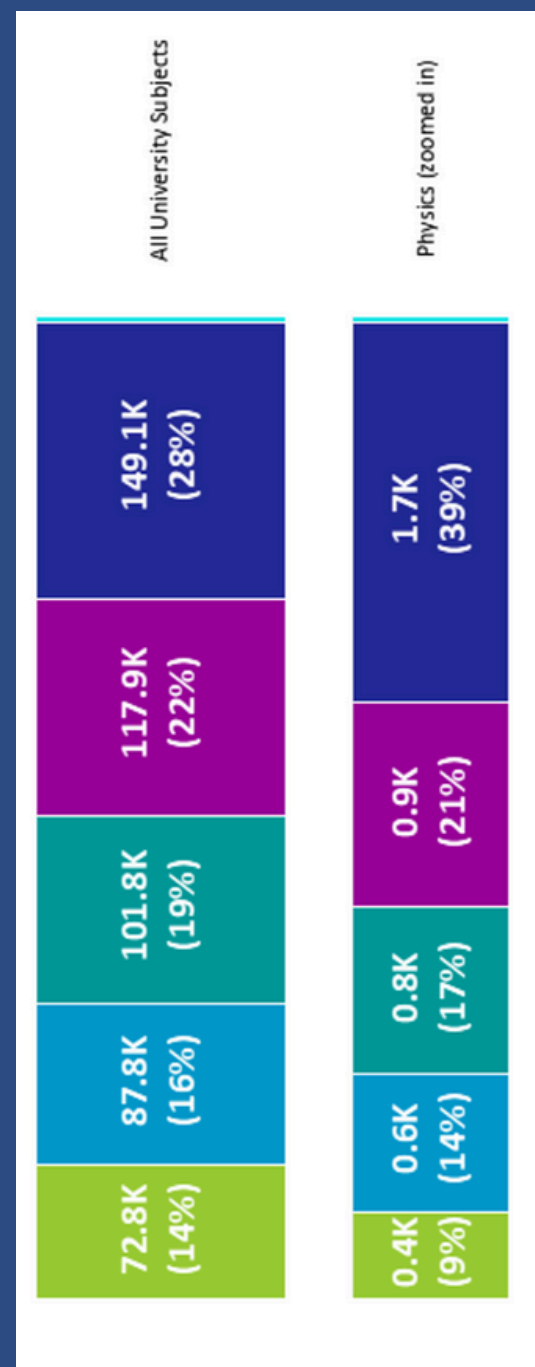
Source: Ofqual

BBC

Data published by the Institute for Fiscal Studies suggests there has been **barely any change** in the attainment gap between **wealthy** and **disadvantaged** pupils at GCSE level for 20 years.

EDI ISSUES IN PHYSICS EDUCATION

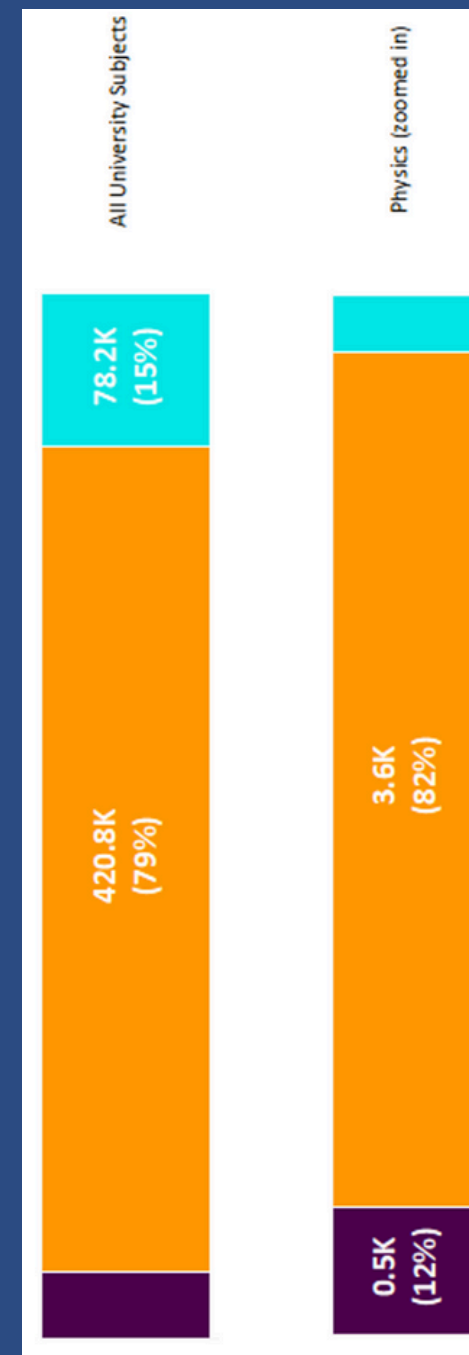
UNIVERSITY STUDENTS DEGREE OF PRIVILEGED BACKGROUND



Physics University Students from the UK are especially likely to come from **more advantaged** parts of the country

Characteristic

- Unknown/Not applicable
- Quintile 5 (Least disadvantaged)
- Quintile 4
- Quintile 3
- Quintile 2
- Quintile 1 (Most disadvantaged)



Among comparable subjects, Physics students are the most likely to have attended **privately funded** schools

- Unknown/Not applicable
- State funded school or college
- Privately funded school

IOP Institute of Physics

Funding & Support



Science and Technology Facilities Council (STFC) Funding for Public Engagement:

- Public Engagement Spark Awards
- Public engagement Nucleus awards
- Leadership fellowships in public engagement



The Wonder Initiative focuses on working with participants from the 40% most socioeconomically deprived areas of the UK, in particular eight to 14-year-olds and their families and carers

The **Institute Of Physics (IOP)** Limit Less campaign supports young people to change the world and fulfil their potential by doing physics



Apply for £500 - £4,000
Three rounds a year!

IOP Institute of Physics

OPEN DAYS IN UK LABS

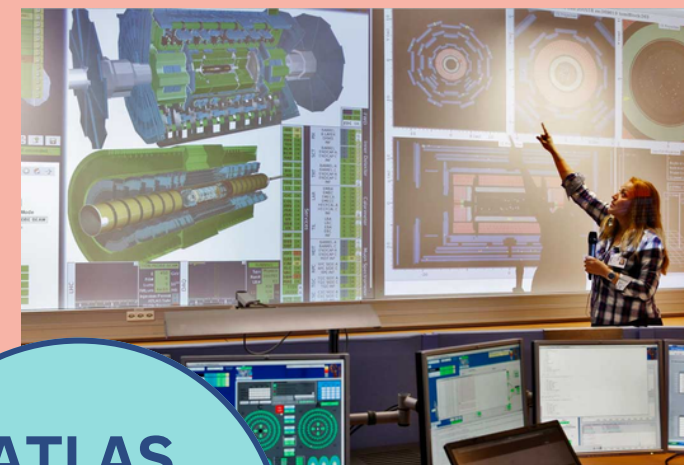
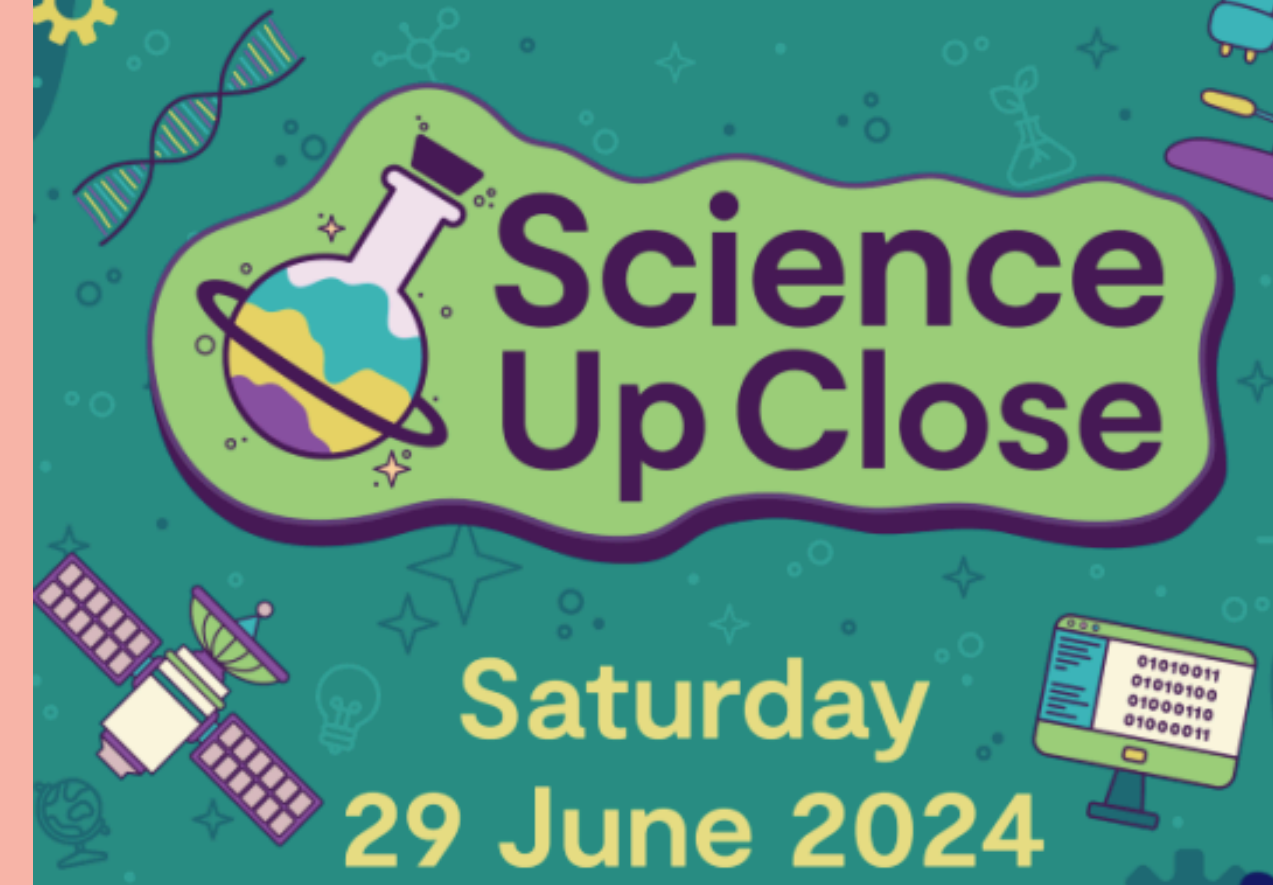
DARESBURY LABORATORY OPEN WEEK



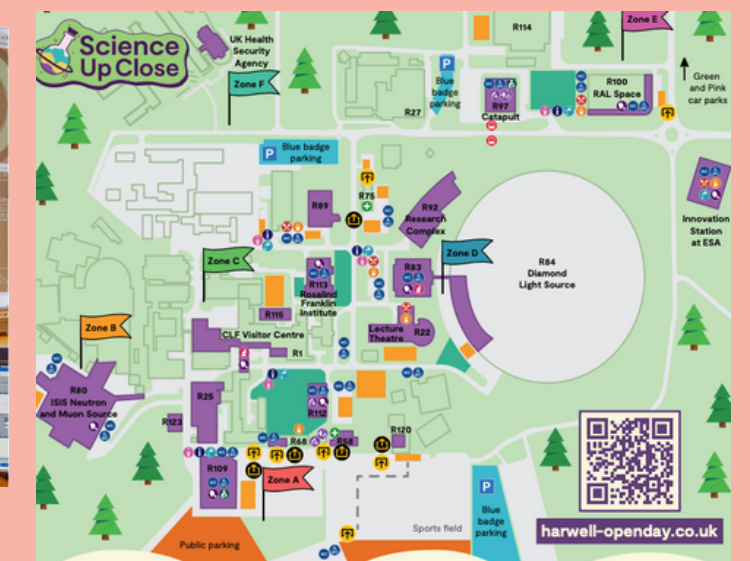
More than
5,000 visitors
from across
the North West

Rutherford Appleton Laboratory OPEN DAYS

Family fun | Science | Technology
Computing | Workshops | Tours



ATLAS
VIRTUAL
VISIT

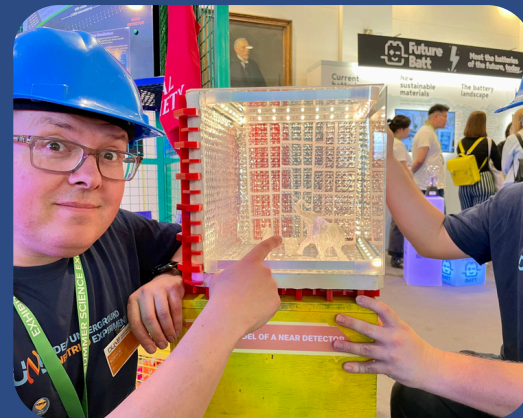


UK FESTIVALS

WOMAD



ROYAL SOCIETY



FESTIVAL OF TOMORROW



BLUEDOT



CERN
LANCASTER
SUSSEX
IOP

WOMAD
THE WORLD'S FESTIVAL



Conference for Undergraduate Women and Non-Binary Physicists UK and Ireland (CUWiP+)



The goal of the conference is to encourage undergraduates to remain in the physics field by:

- improving knowledge of physics and astronomy
- focusing on development as a scientist
- meeting inspirational women and those who identify as non-binary in physics
- connecting, building connections and sharing experiences with other physics students
- increasing confidence to apply for postgraduate studies or starting a career in physics

Outreach Roles at CERN

ATLAS & LHCb OUTREACH CO-COORDINATORS



UK is member of the
International Particle Physics
Outreach Group (IPPOG)
Collaboration



Darren Price, 2022-2024
University of Manchester



Clara Nellist, 2019-2021
University of Amsterdam
and Nikhef



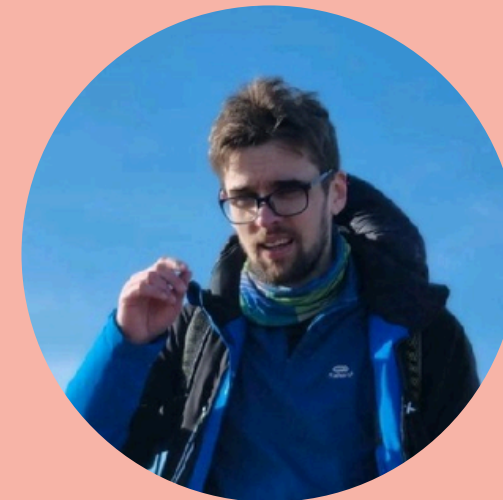
Kate Shaw, 2014 - 2019
ICTP & the University of
Sussex



Harry Cliff, 2019-2022
University of Cambridge



Mark Williams, 2021-2023
University of Edinburgh



Gediminas Sarpis, 2023-20225
University of Edinburgh

Particle Physics Masterclasses

ORGANISED BY IPPOG
ANNUALLY



Each year 100's organised around the world

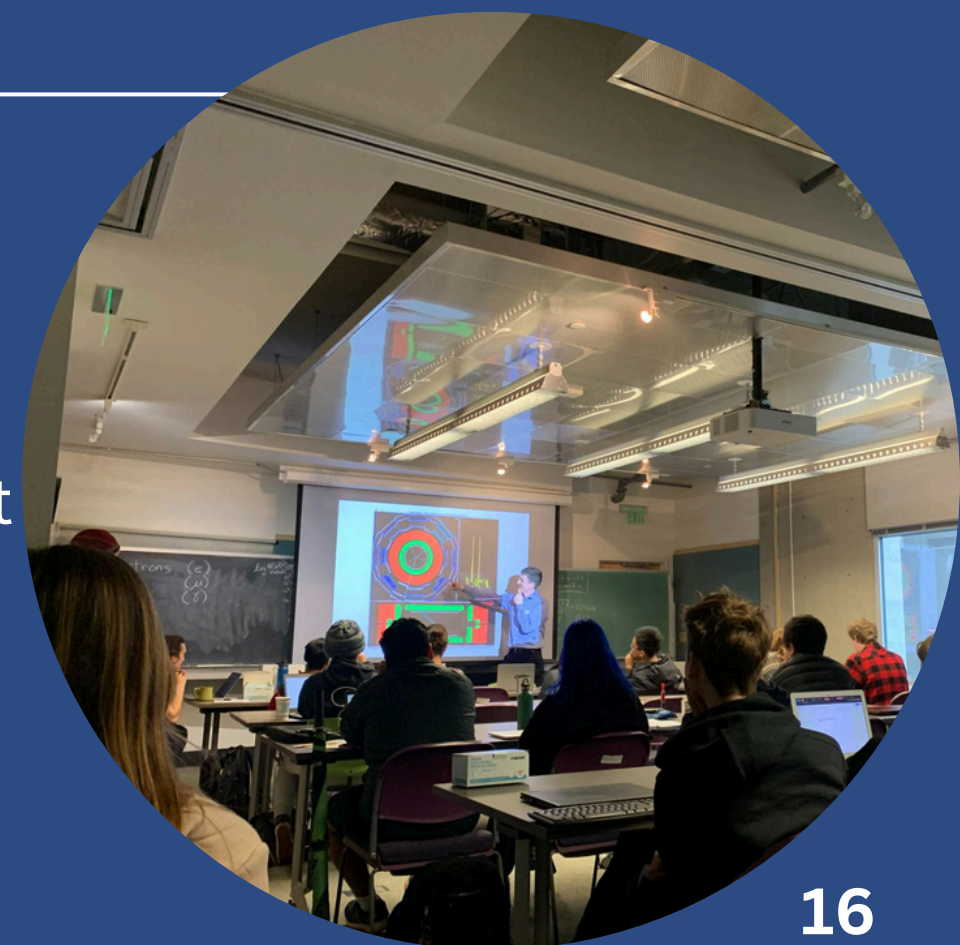
Around 20 UK universities take part, inviting local school students to spend a day being a particle physicist!

Many PhD students and postdocs at CERN take part

Every day at 4pm is the video conference, moderated by CERN scientists

Helps students get a feel for research

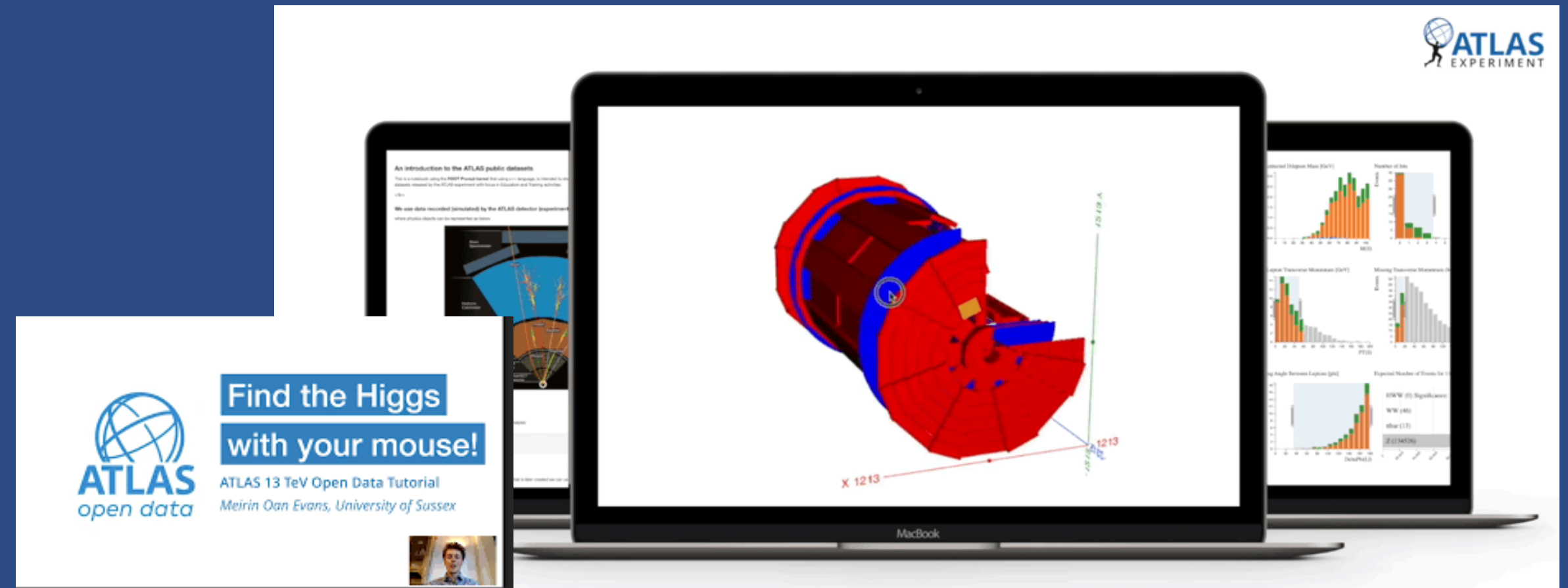
Students get to analyse real data! And get to visit a local university for the day.



ATLAS OPEN DATA

DEVELOPED BY THE ATLAS COLLABORATION

UK is a lead contributor



INTRO TO JUPYTER

OPEN DATA TUTORIAL

ATLAS EXPERIMENT

IRIS RESOURCE

PAST PROJECTS

Higgs Hunters

1958 $\pi \rightarrow e$

Science and Technology Facilities Council

HIGGS HUNTERS

PHYSICS WITHOUT FRONTIERS: BHUTAN

Workshop in Symmetries, Data Science, and AI for Physicists

25th - 29th March 2024

Speaker: Theodor M. Shirobride, College, Kamskhari, Trashigang

Visit: indico.ictp.it/event/10657/

LOCAL COORDINATOR: Man Bahadur Ghaley, Shemshar College, Royal University of Bhutan

SPONSORS: Prof Andrew Ross, University of Sussex, UK; Dr Kate Shaw, ICTP, Italy; & University of Sussex, UK; Dr Rick Taylor, University of Sussex, UK

Particle Physics with ATLAS at the Large Hadron Collider at CERN

Join the presentation from the collaboration of the ATLAS group at the University of Sussex and BHASVIC physics students.

11:50 Wednesday 24th November 2021

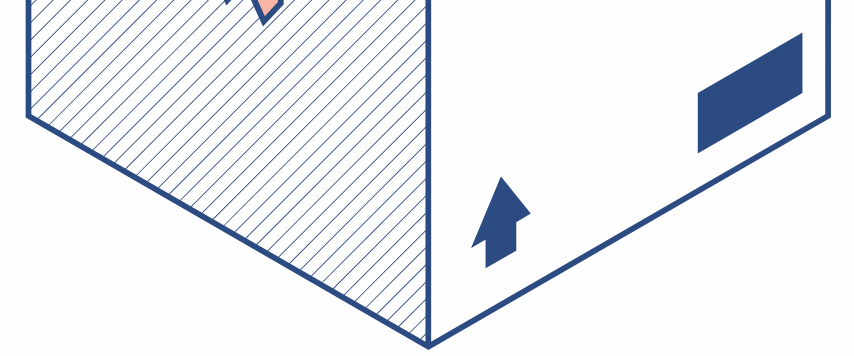
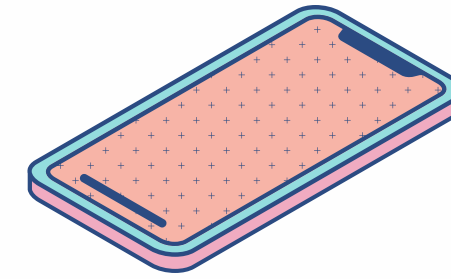
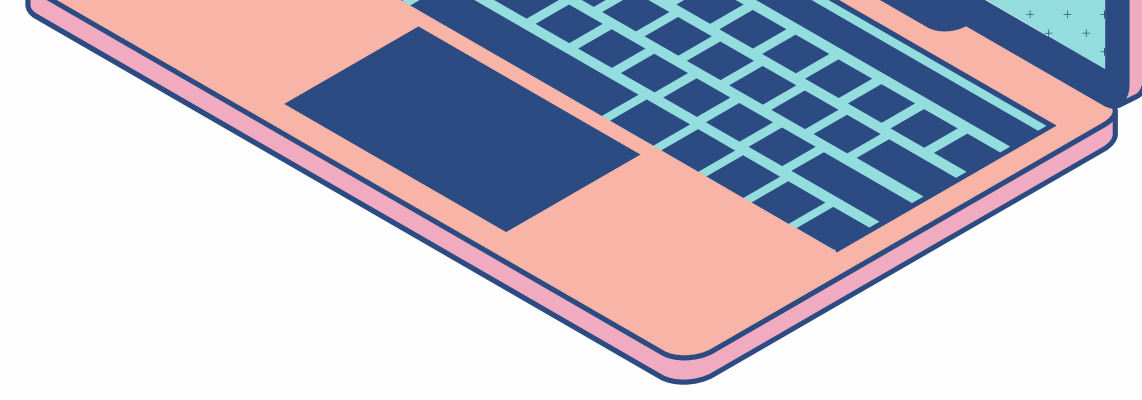
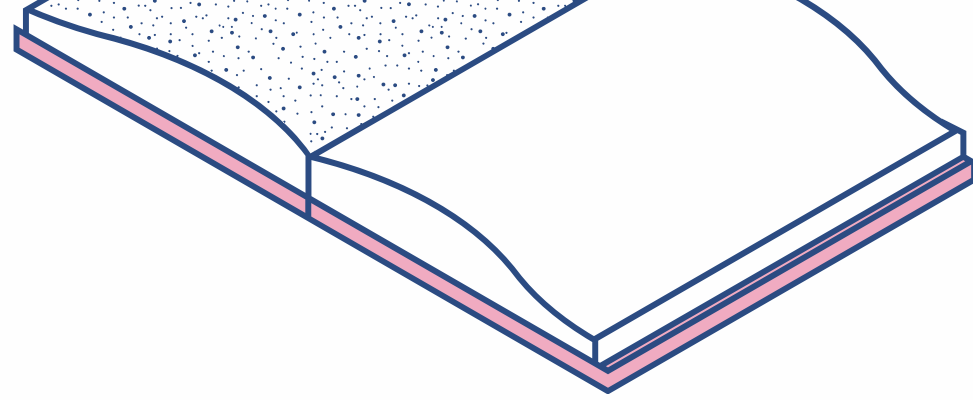
The Sports Cafe

BHASVIC

SEARCH for particles at the Large Hadron Collider

The ATLAS Open Data project...
The School of Physics and Astronomy's Research in Schools programme aims to share the opportunity to support physics education in schools and to support research projects.

qmul.ac.uk/spa/researchinschools



OUTLOOK

Strengths

- UK Physics public engagement and outreach is one of the **best in the world**, however further investment is needed
- Plenty of research into **problems of inclusion and diversity** in physics, fantastic **publications** that benefit the international committee too
- Good **community of scientists** working in public engagement, in the UK and at CERN

Weaknesses

- UK still has a **lack of physics graduates**, lack of **physics teachers**, poor **career pathways**, limited funding for initiatives or long term strategies
- Issues in **EDI are systemic**, change is happening but very slowly, bigger effort from government and society needed
- Universities could **work together more**, and insist to focus on under privileged students and regions

Thank you!

Our UK community is very proud of the UK physics education and outreach agenda, however many issues remain that must be addressed.

THANKS TO IOP AND STFC FOR INPUT TO THIS TALK

