

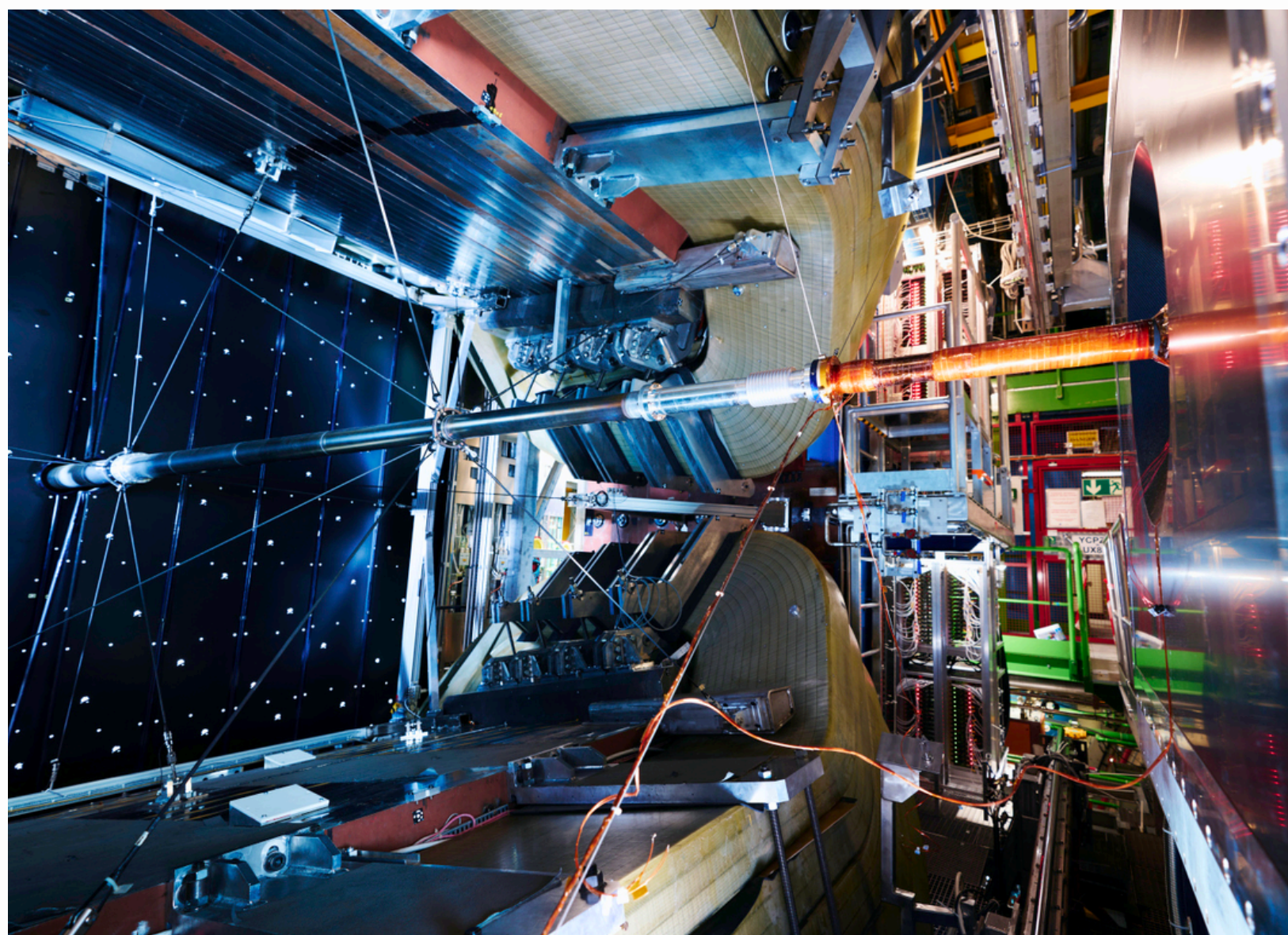
Outreach and Diversity in HEP

KATE SHAW
UNIVERSITY OF SUSSEX

Imperial Collage, London
16 January 2026



Diversity and Outreach in High Energy Physics



High Energy Physics is inherently **international**, and our community understands that to get the **best talent** we need to encourage diversity, equity and inclusion!

To achieve our ambitious goals in HEP we need **national** and **international support**.

As scientists we know it's our responsibility to reach out to the public, students and policy makers to **communicate** what we do and why!

EDI: Very important for our community

Equity: Treating people of all identities and backgrounds fairly and respectfully with regard to opportunities, access, treatment, power, outcomes, and resources.

Diversity: Embracing differences, which may include ethnicity, gender identity or expression, family status, disability status, sexual orientation, age, and socioeconomic situation.

Inclusion: Intentionally creating welcoming and respectful environments and systems in which inequities in power and privilege are addressed and everyone is given an opportunity to flourish.



Mark Thomson, CERNs new Director General

“I am really passionate about the importance of diversity in all its forms and this includes national and regional inclusivity.”

“It is an agenda that I pursued in my last two positions. At the Deep Underground Neutrino Experiment, I was really keen to engage the scientific community from Latin America, and I believe this has been mutually beneficial. At STFC, we used physics as a way to provide opportunities for people across Africa to gain high-tech skills. ”



Mark Thomson, CERN's new Director General

Inclusivity

The goal: “establish CERN as a beacon of inclusivity in science, actively promoting diversity in all its forms and providing an environment where all can thrive”

- I believe a high-level of ambition with regards to diversity, equality and inclusivity is essential for CERN (and indeed any other large organization) to thrive
- We will develop a detailed inclusivity action plan with clear steps...

Some immediate actions

- Establish a new biennial diversity and inclusivity report with the goal to develop a pipeline of possible actions to be implemented by CERN management
- Build on existing goals for gender balance in both recruitment (in all roles) and progression
- I intend to introduce as soon as possible our maternity/paternity offering:
 - Doubling the paternity/partner leave from 2 to 4 weeks (following concertation with the Staff Association and Council approval)
 - Immediately moving to a 5-month maternity leave provision, rather than 4 + 1

Inclusivity is an important part of my personal values and I strongly believe it is important for CERN's continued success

DIVERSITY IS THE KEY TO SUCCESS OF PHYSICS

Monoculture can create mono approaches

A group of people with different experiences and **perspectives** brings **innovation** and creativity

If certain groups are under-represented, our **talent pool** is smaller

We see that the more diverse a group is, the more **inclusive** it becomes for everyone, and more people are attracted to a **welcoming** environment



Is Physics Diverse?

Well.. not as much as we would like

Nationally

- Many under-represented groups in physics (aspects such as gender, sexuality, disability, ethnicity, social-economic background, geographical location)
- Its not enough for under-represented groups to be welcomed, they must also **have a seat and a voice at the table**



IOP Report on the Potential of Physics



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

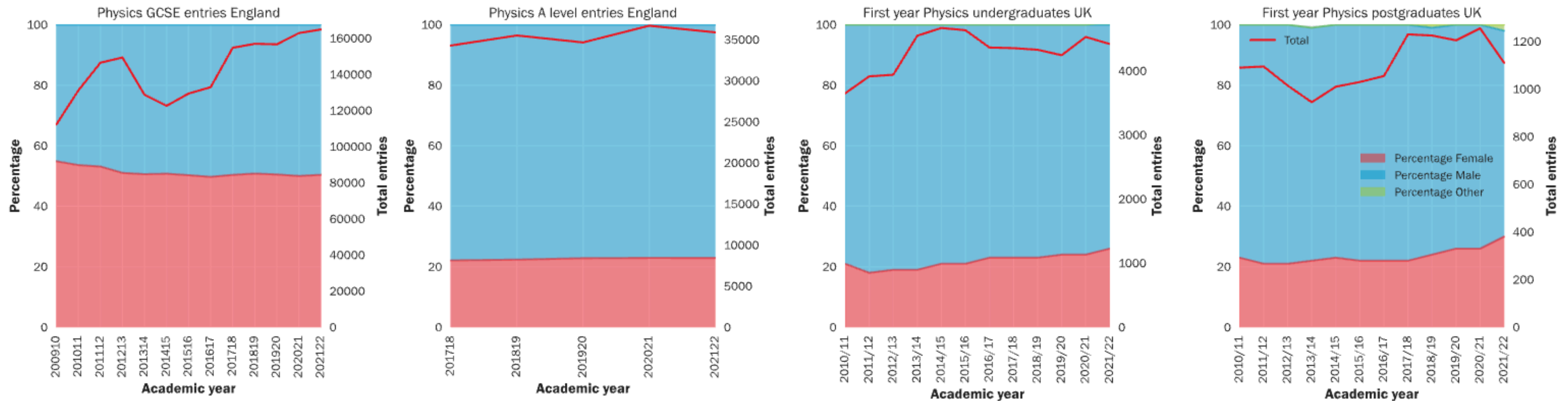
What are the most significant barriers preventing the UK from developing the workforce needed for physics R&D to thrive?

- 1. Teaching workforce challenges:** There are serious shortages of teachers with a physics background in secondary and further education.
- 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.

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

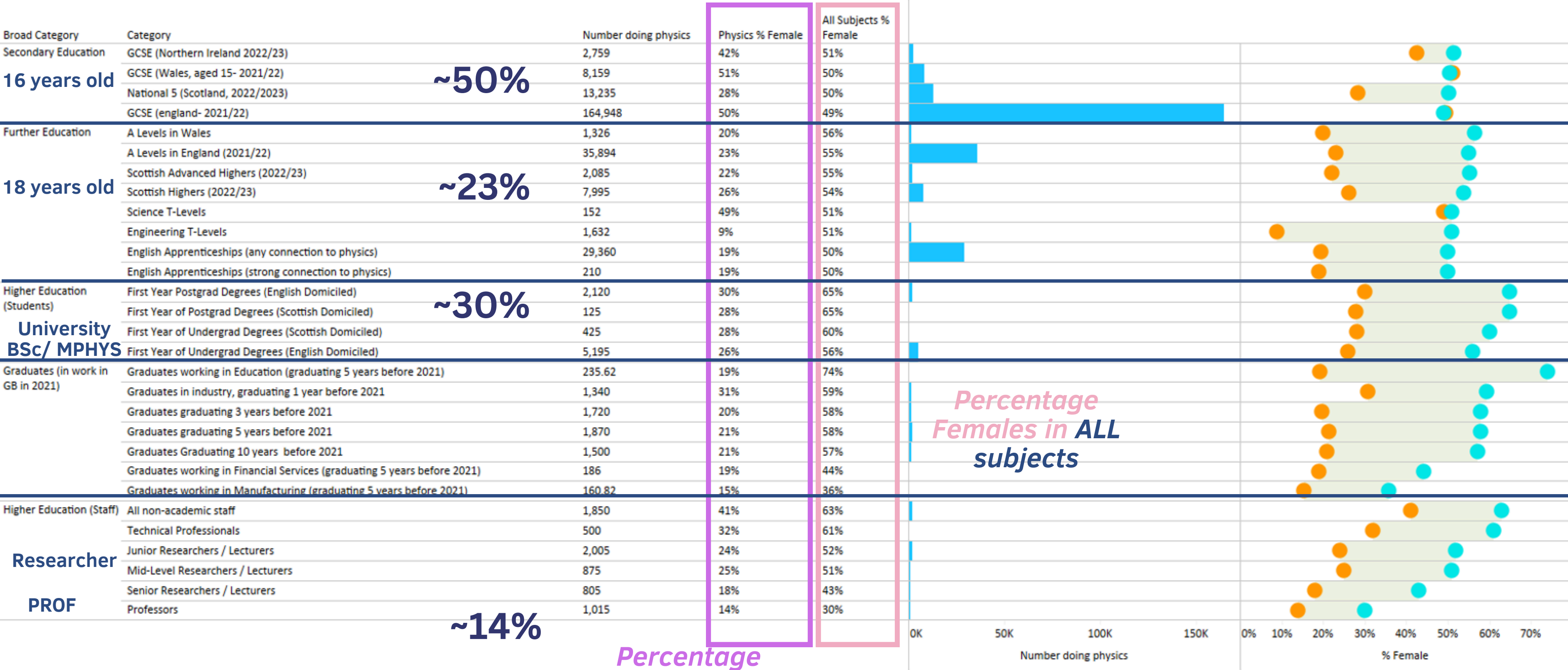
IOP: Physics Education in Schools & Universities

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



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.



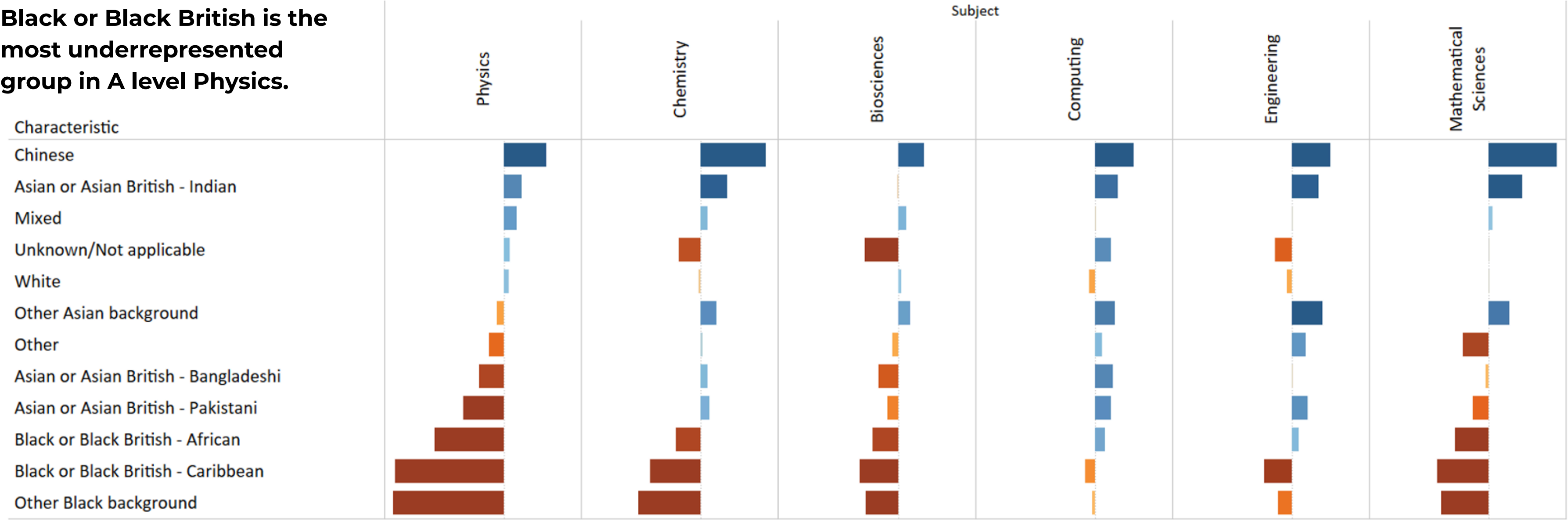
Sources:
Department for Education (England)
SQA (Scotland)
CCEA (Northern Ireland)
StatWales (Wales)
HESA / JISC (University Data)
IOP

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

IOP: University Physics Student Ethnicity

Representation Level

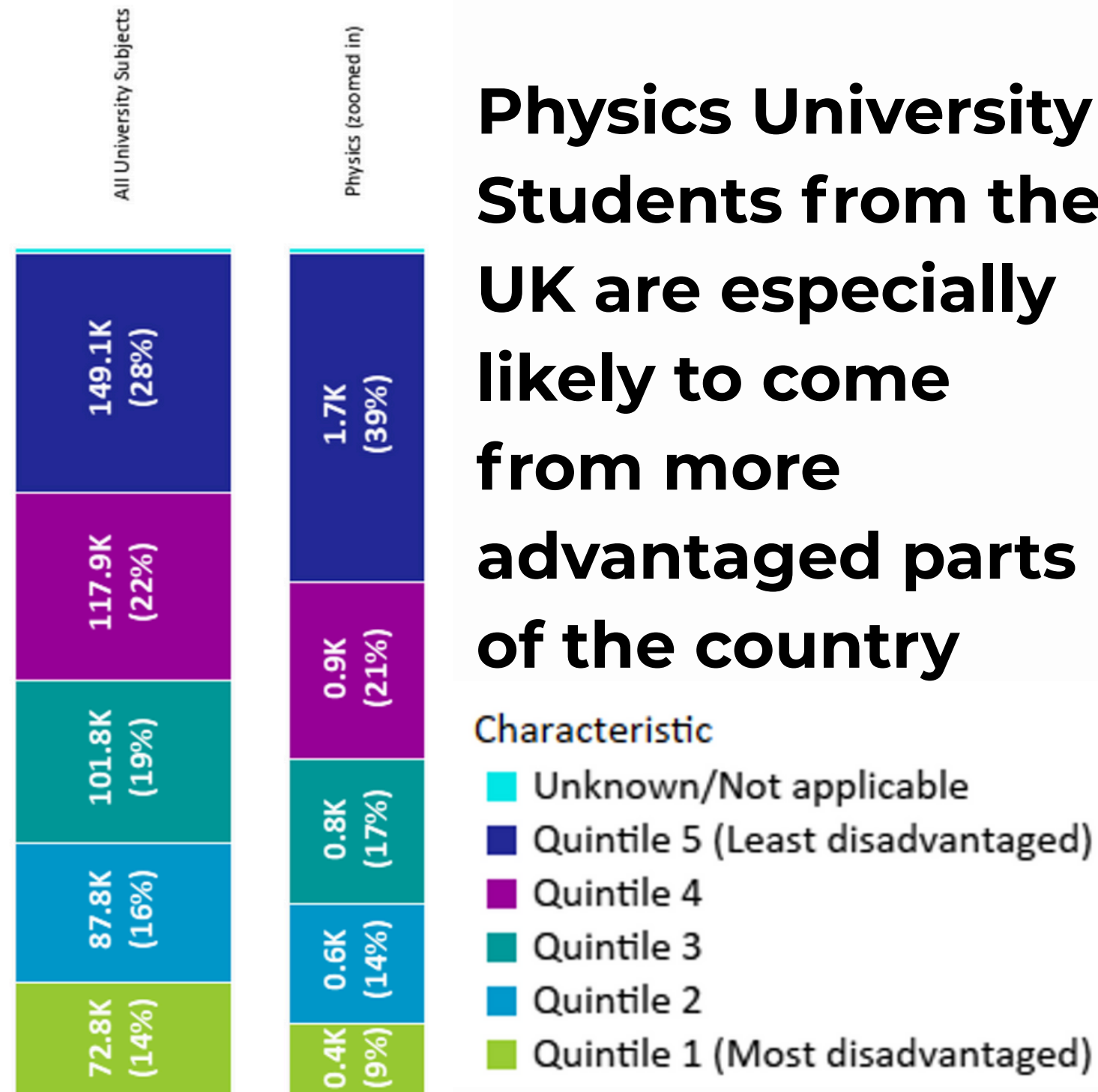
Black or Black British is the most underrepresented group in A level Physics.



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

Sources: Department for Education (DfE), HESA/JISC

IOP: Socio-economic background



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



Promoting EDI in Physics

- In our different scientific communities we must work on cultivating an **inclusive environment for all**
- **Investigate** and tackle **barriers** and **issues** encountered by different groups and different stages of their careers
- Develop **outreach initiatives** to encourage the next generation of scientists, focused on those under represented groups



Is Physics Diverse?

Well.. not as much as we would like

Internationally countries in the **Global South** fare much worse (in general!!!)

→ Many students, researchers and scientists live in countries that lack educational and **training resources**, their universities lack investment

→ Many scientists do not have any access to research / travel **funding**, or governmental support

→ Many students and young people lack **exposure** to research, and access to research **opportunities**

→ **This costs us valuable talent and scientists!**

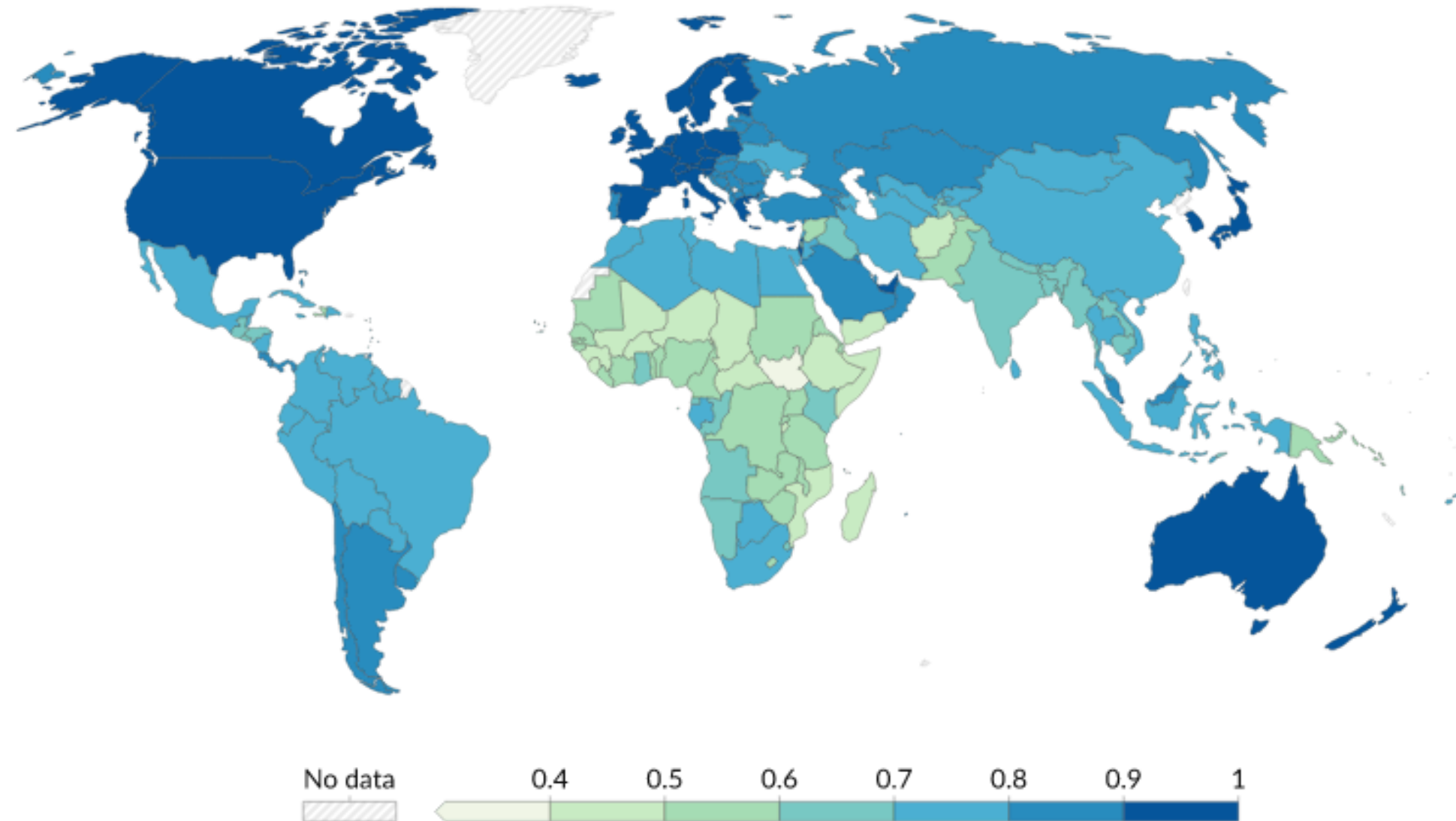


Research Gap between Global North and South

Human Development Index, 2023

Our World
in Data

The Human Development Index (HDI) is a summary measure of key dimensions of human development: a long and healthy life, a good education, and a decent standard of living. Higher values indicate higher human development.



Data source: UNDP, Human Development Report (2025)

OurWorldinData.org/human-development-index | CC BY

Our World in Data

Global South countries account for 80% of the world's population but only 28% of the world's scientists come from these countries

UNESCO Science Reports

Physics for Sustainable Development

Countries at all income levels are looking to transition towards **digital and green economies** and **sustainably develop**

This vitally involves **investment into science**, and accelerating technology transfer into industry

To reach SDG by 2030 countries will need to **invest** more into **scientific research** and innovation

The Sustainable Development Goals Report: <https://sdgs.un.org/documents/sustainable-development-goals-report-2023-53220>



Physics for Sustainable Development

Physics **outreach** and **communication** in all countries around the world is vital to promote **scientific literacy** in the population:

School students benefit from **enquiry-based learning** (observation, measurement and experimentation)

Understanding scientific discovery requires continual **readjustment** with new **facts**

Democracy relies on a scientific literate population



International Cooperation

International cooperation builds
bridges across nations, **soft diplomacy**
has real impact

CERN has become a model for
cooperation in terms of research,
embodying the ‘one-earth’ approach
that the world needs to tackle the
global challenges we are facing.



28 March 2025 18

Today CERN has 24 member states
Over 12000 scientists from ~110 nations use
CERN's laboratories.

International Cooperation

SESAME: Synchrotron-light for Experimental Science and Applications in the Middle East, Jordan.

Pooling resources to build scientific capacity within the region, create research and career **opportunities** that can limit the brain drain

Functions as a **bridge** between its diverse culturally and politically conflicting societies



ICTP Physics Without Frontiers @ictpPWF

Internationally, richer countries have the lions share of scientists, funding, supportive scientific environments

- many countries **lack resources** and their universities lack investment
- many scientists do not have the same access to **funding** and governmental support
- many students and young people **lack exposure, access and opportunity**
- **This costs us valuable scientists!**



Dr Wafaa Khater, Birzeit University, Palestinian Territories.

- Lacks time for research
- No access to research grants
- No funding to travel to conferences to present results and meet new collaborators

Physics Training & Outreach

We must reach out to students and researchers across the **world**

- Seek out & provide **study** (MSc/PhD) or training **opportunities**
- **Provide funding** for students/scientists to come to your **conference or workshop** (or/and provide free online access)
- Build cooperation and **networks** with new collaborators
- Go to conferences in **underrepresented** regions



**Physics Without
Frontiers**

[ictp.it/home/physics-
without-frontiers](http://ictp.it/home/physics-without-frontiers)

AIMS
nexteinstein.org

**African School of
Physics**
africanschoolofphysics.org/

**Scholar Rescue
Fund**
scholarrescuefund.org/

ICTP Physics Without Frontiers @ictpPWF

ICTP Physics Without Frontiers works to teach, train and motivate physics and mathematics university students worldwide to help build the next generation of scientists. Each project is unique, developed with the country's specific needs in mind.

- **Inspire** and **motivate** the next generation of physicists
- **Train** and **educate** those with hands-on physics and transferable skills
- **Collaborate**, providing stimulating networking environments
- **Mentor** students onto further study and provide career advice



HEP Workshop, Afghanistan

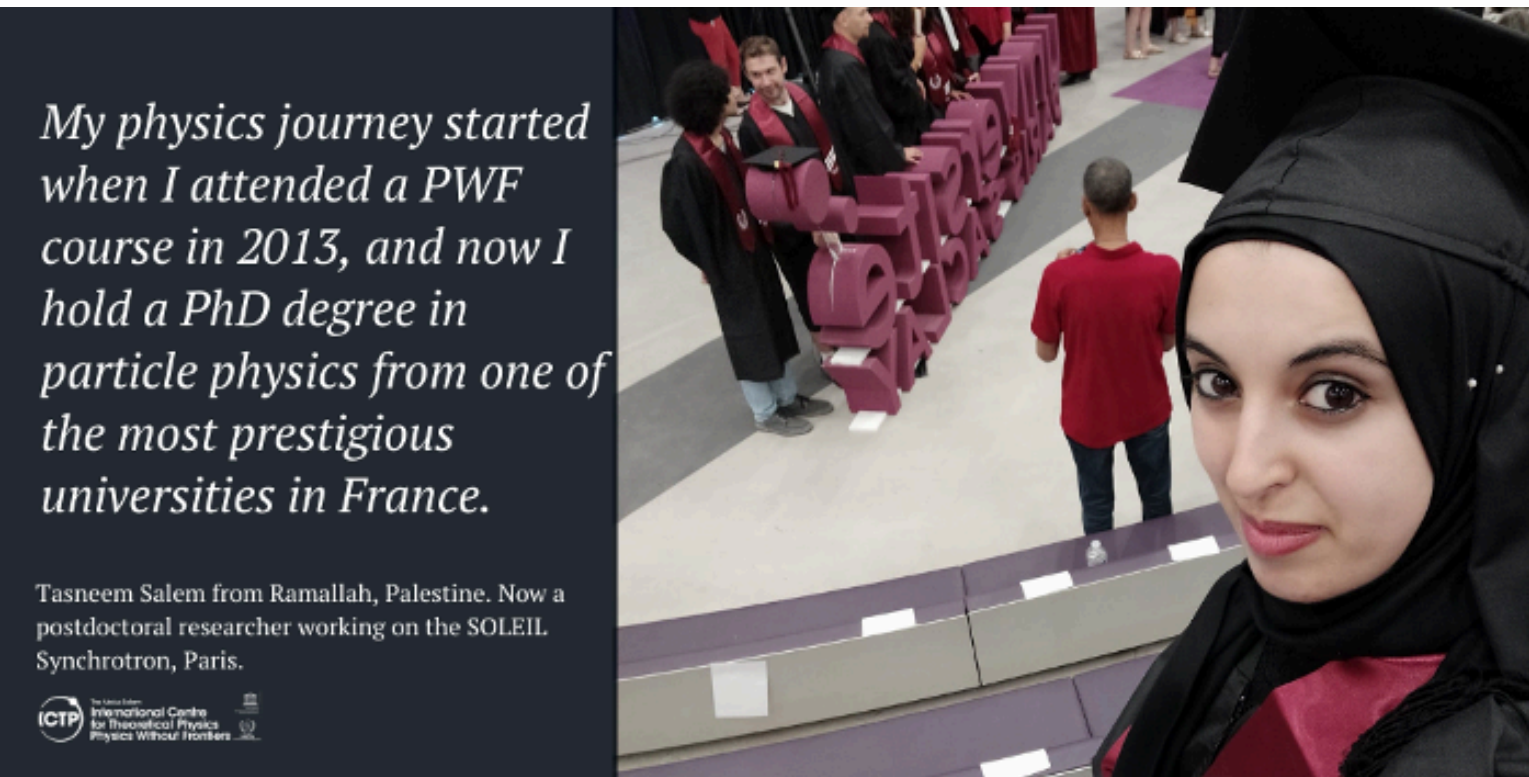


18/02/2022 17:46

ICTP Physics Without Frontiers @ictpPWF

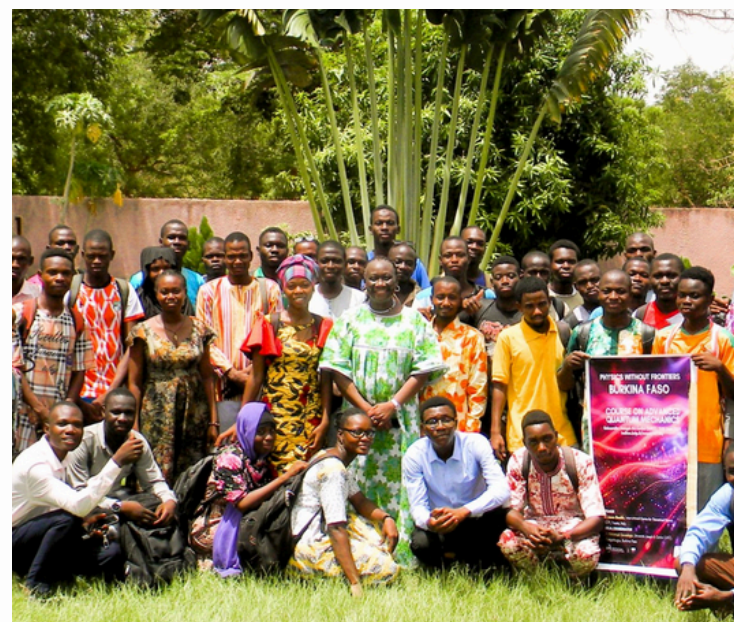
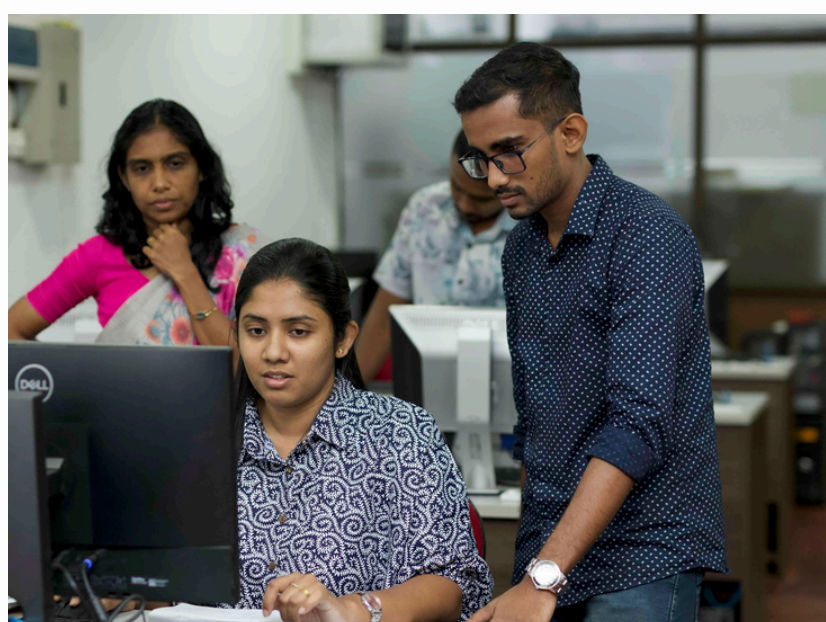
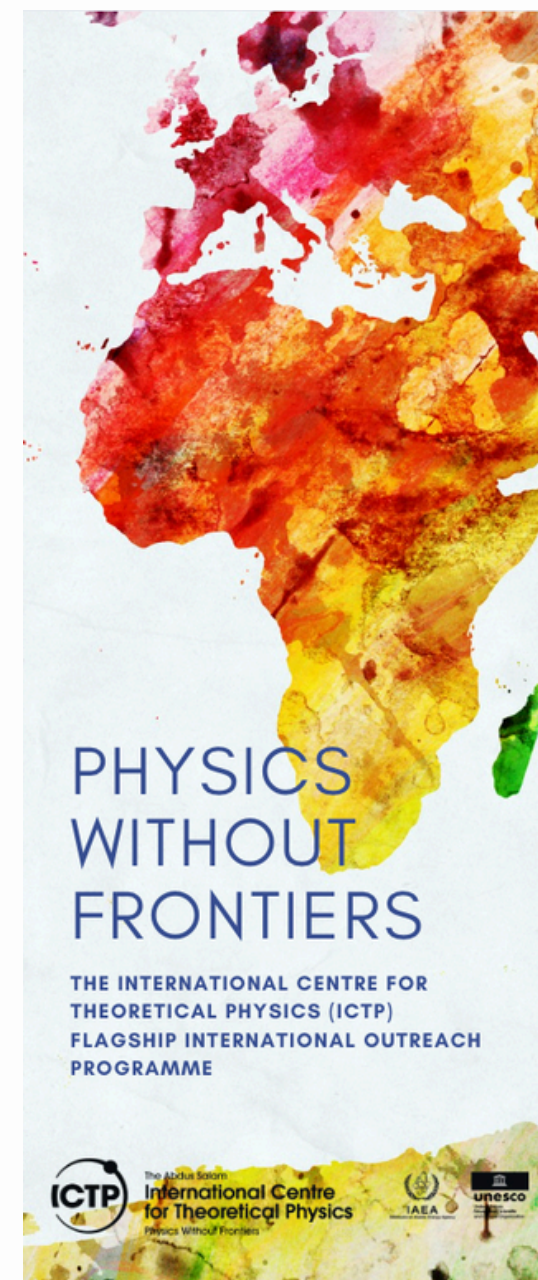
Aims of the Project

- To **expose** and introduce new ideas in physics to undergraduate and master students, provide **courses** and **training** in key analysis and transferable skills
- To identify top students, provide mentoring and support for further study and career
- To **connect** with scientists, build **networks** and support them with international opportunities and collaboration
- Bring **awareness** to the university and **policy makers** to the importance of supporting physics departments and ultimately research



ICTP Physics Without Frontiers @ictpPWF

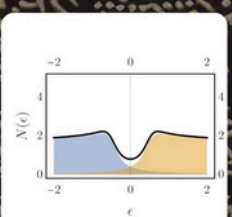
We run around 25 PWF projects around the world every year, in all areas of physics with some focus on least developed countries and conflict regions



ICTP Physics Without Frontiers @ictpPWF

PHYSICS WITHOUT FRONTIERS: MALI

COURSE ON ORDINARY DIFFERENTIAL EQUATIONS USING GREEN'S FUNCTION



Date: 5 - 16 MAY 2025
Location: Faculty of Sciences and Techniques, University of Sciences, Techniques and Technologies of Bamako (USTTB), Mali
Indico: indico.ictp.it/event/11004/

SPEAKER:
Dr. Laure GOUBA, International Centre for Theoretical Physics (ICTP), Trieste, Italy


LOCAL COORDINATOR:
Dr. Kaniba Mady KEITA, Faculty of Sciences and Techniques, University of Sciences, Techniques and Technologies of Bamako (USTTB), Mali

Logos: ICTP, IAEA, UNESCO

PHYSICS WITHOUT FRONTIERS: SUDAN

EXPANDING PHYSICS HORIZONS IN SUDAN: LEVERAGING ONLINE SEMINARS FOR GROWTH

1 JUNE - 16 JULY 2025



Registration: tiny.cc/PWFSudan
Webpage: indico.ictp.it/event/11030/

Project coordinators:
Alaa Mohammed Idris Bakhit, Materials Physics Center (MPC), Spain
Dr. Abubakar Y. A. Ibrahim, Institute of Space Sciences (ICE) & Universidad Autónoma de Barcelona (UAB), Spain

Local Organizing Committee:
Dr. Elbasher M. E. Ahmed, Mohammed Y. A. Eldaw, Hazim E. Y. El Sheikh, Ebtihal Siraj Mohammad Othman, Migdad Yahya, Gotiba Hamza.

Logos: PWF, ICTP, IAEA, UNESCO

PHYSICS WITHOUT FRONTIERS ECUADOR

EPIQ V - BRIDGING EMPIRICAL DATA AND SIMULATIONS: FROM ASTROPHYSICS TO COMPUTATIONAL BIOPHYSICS

4 - 8 AUGUST 2025



Indico: indico.ictp.it/event/11049/
Registration Form: tinyurl.com/PWFECUADOR


Speakers and Coordinators:
Hernán Andrés Morales-Navarro, UDLA, Ecuador
Paulina Vizcaino, UIDE, Ecuador
Wladimir Banda-Sarragán, Yachay Tech, Ecuador
Helga Dénes, Yachay Tech, Ecuador
Lupe Villegas, CSIC-UAM, Spain
Edison Salazar, Leiden University, Netherlands

Logos: UIDE, Yachay Tech, ICTP, IAEA, UNESCO

PHYSICS WITHOUT FRONTIERS BANGLADESH

SCHOOL ON GENERAL RELATIVITY AND COSMOLOGY

28 MAY - 15 JULY 2025



Register: indico.ictp.it/event/11010/
Deadline: 14 MAY 2025

This school will provide an introduction to General Relativity at MSc level. A pre-school will be provided to give an overview of the important concepts in special relativity. The School will commence with 8 x 2-hour lectures covering tensor calculus, the mathematics of curved spacetimes, and the basics of Einstein's theory of relativity. More advanced topics will then be covered, including an introduction to the theory of black holes and gravitational waves, and the basic FRW theory of cosmology, and ending with a brief summary of inflation.

Programme Coordinators:
Prof. Nabil Iqbal (Durham University, UK & University of Amsterdam, Netherlands)
Ahmed Rakin Kamal (Masaryk University, Czech Republic & Bras University, Bangladesh)
Sayeda Tasnuva Jahan (Bras University, Bangladesh)
Michael Hui (University of Bologna, Italy)

Lecturers:
Prof. Nabil Iqbal (Durham University, UK & University of Amsterdam, Netherlands)
Prof. Nafiz Ishique (IHES, Paris, France)
Hassan Saleem (CUNY, New York, USA)
Luca Brunell (University of Bologna, Italy)

Guest Speakers:
Prof. Clifford Burgess (Perimeter Institute & McMaster University, Canada)
Prof. Samir Mathur (Ohio State University, USA)

Logos: Durham University, MUST, ICTP, IAEA, UNESCO

PHYSICS WITHOUT FRONTIERS UGANDA

EAST AFRICAN TRAINING WORKSHOP ON MACHINE LEARNING AND DATA SCIENCE APPLICATIONS IN SPACE WEATHER AND IONOSPHERIC RESEARCH

8-12 SEPTEMBER 2025



Indico: indico.ictp.it/event/11009/
Location: Ucoffe Boardroom-Mbarara University of Science and Technology (MUST), Uganda
Project coordinator: Dr. Patrick Mungufeni, Muni University, Arua, Uganda

Local Organizing Committee:
Dr. Sharon Aul, Mbarara University of Science and Technology, Mbarara, Uganda
Ms. Yvonne Mpyayo-Oroo, STI unit, ICTP, Trieste, Italy
Dr. Valence Habyarimana, Mbarara University of Science and Technology, Mbarara, Uganda
Dr. Geoffrey Andima, Busitema University, Tororo, Uganda
Dr. Phillip Opio, Mountains of the Moon University, Fortportal, Uganda

Logos: MUST, ICTP, IAEA, UNESCO

PHYSICS WITHOUT FRONTIERS AFGHANISTAN

AFGHAN PHYSICS STUDENTS CONFERENCE 2025

7-8 November 2025
<https://indico.ictp.it/event/10781/>



ORGANISING COMMITTEE:
Bahattar Amin, University of Freiburg, Germany
Chaman Ali Dostdaran, IASBS, Iran
Sharif Hussain, University Medical Center Hamburg-Eppendorf, Germany
Akmal Sajad Nazari, Kabul University, Afghanistan
Zainab Nazari, European Brain Research Institute (EBRI), Italy
Farzila Payandi, IASBS, Iran
Mahammad Rahim, Kabul University, Afghanistan
Said Majeed Sadr, IASBS, Iran
Kate Shaw, ICTP, Italy
Humaira Yaqoobi, IASBS, Iran

Logos: ICTP, IAEA, UNESCO

We work to bring physics to each corner of the Globe, with focus on:

- **Economic Frontiers:** Low income & science & technology lagging countries
- **Social Frontiers:** Women and Girls, cultural frontiers
- **Geographical Frontiers:** Rural and remote areas
- **Sociopolitical Frontiers:** under represented ethnicities and conflict regions or political turmoil

Open Science Movement



Open science is an **accelerator** for the **Sustainable Development Goals (SDGs) 2030** and a powerful tool to bridge the science divide between and within countries

Open science aims at making scientific knowledge openly **available, accessible** and **reusable**.

The key elements include open access to scientific publications, **data**, educational resources, software and hardware, and open infrastructures

[UNESCO Open Science website](https://www.unesco.org/en/open-science)

[Open Science at CERN website](https://open-science.cern.ch/)

CERN OPEN DATA POLICY

Level 1: Published Results

- Available with Open Access
- HEPData: Repository for publication-related HEP data
- Rivet toolkit: Robust Independent Validation of Experiment and Theory

Level 2: Outreach and Education

- Dedicated subsets of data selected and formatted to provide rich samples to maximise their educational impact, and to facilitate the easy use of the data.

Level 3: Reconstructed Data

- Experiments release calibrated reconstructed data useful for algorithmic, performance and physics studies

Level 4: Raw Data – Not feasible

CERN Open Data Policy for the LHC Experiments.”
<https://cds.cern.ch/record/2745133> , November 2020

CERN Open Data Policy for the LHC Experiments November, 2020

The CERN Open Data Policy reflects values that have been enshrined in the CERN Convention for more than sixty years that were reaffirmed in the European Strategy for Particle Physics (2020)¹, and aims to empower the LHC experiments to adopt a consistent approach towards the openness and preservation of experimental data. Making data available responsibly (applying FAIR standards²), at different levels of abstraction and at different points in time, allows the maximum realisation of their scientific potential and the fulfillment of the collective moral and fiduciary responsibility to member states and the broader global scientific community. CERN understands that in order to optimise reuse opportunities, immediate and continued resources are needed. The level of support that CERN and the experiments will be able to provide to external users will depend on available resources.

This policy relates to the data collected by the LHC experiments, for the main physics programme of the LHC — high-energy proton–proton and heavy-ion collision data. The foreseen use cases of the Open Data include reinterpretation and reanalysis of physics results, education and outreach, data analysis for technical and algorithmic developments and physics research. The Open Data will be released through the CERN Open Data Portal which will be supported by CERN for the lifetime of the data. The data will be tailored to the different uses, and will be made available in formats defined by each experiment that afford a range of opportunities for long-term use, reuse and preservation. In general, four levels of complexity of HEP data have been identified by the Data Preservation and Long Term Analysis in High Energy Physics (DPHEP) Study Group³, which serve varying audiences and imply a diversity of openness solutions and practices.

Published Results (Level 1) Policy: Peer-reviewed publications represent the primary scientific output from the experiments. In compliance with the CERN Open Access Policy, all such publications are available with Open Access, and so are available to the public. To maximise the scientific value of their publications, the experiments will make public additional information and data at the time of publication, stored in collaboration with portals such as HEPData,⁴ with selection routines stored in specialised tools. The data made available may include simplified or full binned likelihoods, as well as unbinned likelihoods based on datasets of event-level observables extracted by the analyses. Reinterpretation of published results is also made possible through analysis preservation and direct collaboration with external researchers.

Outreach and Education (Level 2) Policy: For the purposes of education and outreach, dedicated subsets of data are used, selected and formatted to provide rich samples to maximise their educational impact, and to facilitate the easy use of the data. These data are released with a schedule and scope determined by each experiment. The data are provided in simplified, portable and self-contained formats suitable for educational and public understanding purposes; but are not intended nor adequate for the publication of scientific results. Lightweight environments to allow the easy exploration of these


¹ European Strategy Group (2020), ‘2020 Update of the European Strategy for Particle Physics’.

² FAIR Guiding Principles for scientific data management and stewardship. Available at: <https://www.go-fair.org/fair-principles/>.

³ Data management plans are defined by the LHC experiments to address the long-term preservation of internal data products. See: Akopov et al., Status report of the DPHEP Study Group: Towards a global effort for sustainable data preservation in high energy physics. arXiv preprint arXiv:1205.4667 (2012).

⁴ Repository for publication-related High-Energy Physics data: <http://www.hepdata.net>.

CERN OPEN DATA PORTAL



Help ▾ About ▾

Explore more than **five petabytes** of open data from particle physics!

Search

search examples: [collision datasets](#), [keywords:education](#), [energy:7TeV](#)

Explore

[datasets](#)

[software](#)

[environments](#)

[documentation](#)

Focus on

[ALICE](#)

[ATLAS](#)

[CMS](#)

[DELPHI](#)

[LHCb](#)

[OPERA](#)

[PHENIX](#)

[TOTEM](#)

[Data Science](#)

ATLAS \sqrt{s} simulation for ML-based jet flavour tagging (JetSet)

Flavour-tagging — the task of identifying the flavour of jets — is essential for many physics analyses at the ATLAS experiment. This dataset provides simulated jets for training and evaluation of machine learning models.

[Dataset](#) [Derived](#) [Simulated](#) [ATLAS](#)

ATLAS releases first open data from heavy-ion collisions

The ATLAS Collaboration has released its first open data of heavy-ion collisions for research purposes. This data includes a nucleus-nucleus collision, recorded in 2015 as part of the Large Hadron Collider's second operation period (LHC Run 2).

[News](#) [ATLAS](#)

ATLAS releases 65 TB of open data for research

Explore over 75 billion LHC collision events — from home

[News](#) [ATLAS](#)

ATLAS DAOD_HION14 format Run 2 2015 Pb-Pb MC simulation

Run 2 2015 Pb-Pb MC simulation from the ATLAS experiment

[Dataset](#) [Simulated](#) [Heavy-Ion Physics](#) [ATLAS](#)

ATLAS DAOD_HION14 format Run 2 2015 Pb-Pb collision data

Run 2 2015 Pb-Pb collision data from the ATLAS experiment

[Dataset](#) [Collision](#) [ATLAS](#)

DAOD_HION14 format 2015 Pb-Pb Open Data for Research from the ATLAS experiment

2015 Pb-Pb Open Data for Research from the ATLAS experiment

[Dataset](#) [Simulated](#) [Collision](#) [Heavy-Ion Physics](#) [ATLAS](#)

ATLAS top tagging open data set with systematic uncertainties

Boosted top tagging is an essential binary classification task for experiments at the Large Hadron Collider (LHC). This dataset provides open data for research purposes.

[Dataset](#) [Derived](#) [Simulated](#) [ATLAS](#)

DAOD_PHYSLITE format 2015-2016 Open Data for Research from the ATLAS experiment

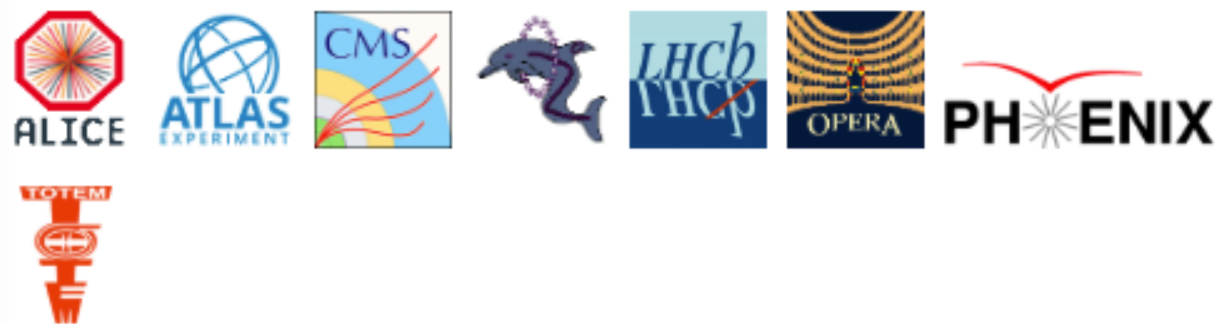
2015-2016 Open Data for Research from the ATLAS experiment

[Dataset](#) [Simulated](#) [Collision](#) [ATLAS](#)

ATLAS DAOD_PHYSLITE format MC simulation top systematic variation samples

MC simulation top systematic variation samples from the ATLAS experiment

[Dataset](#) [Simulated](#) [Standard Model Physics](#) [Top physics](#) [ATLAS](#)

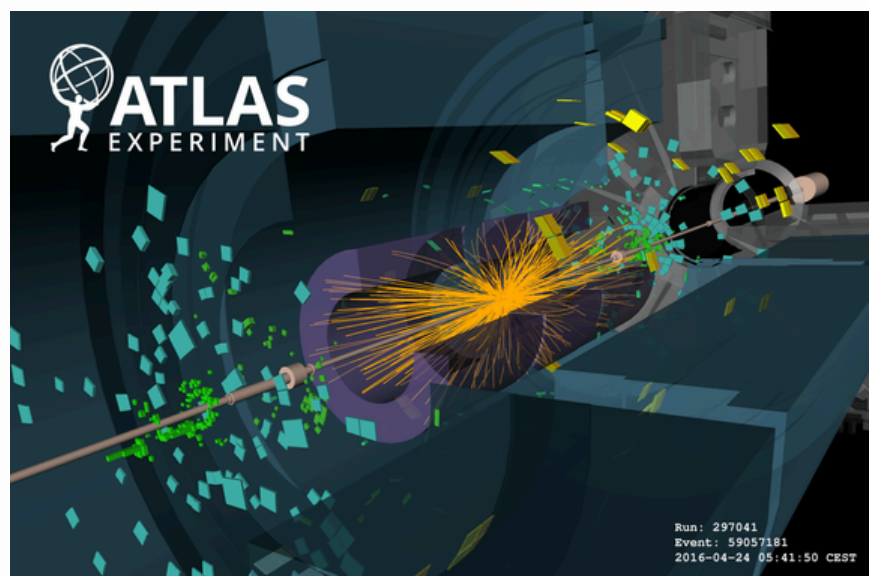


<https://opendata.cern.ch>

ATLAS OPEN DATA for Research

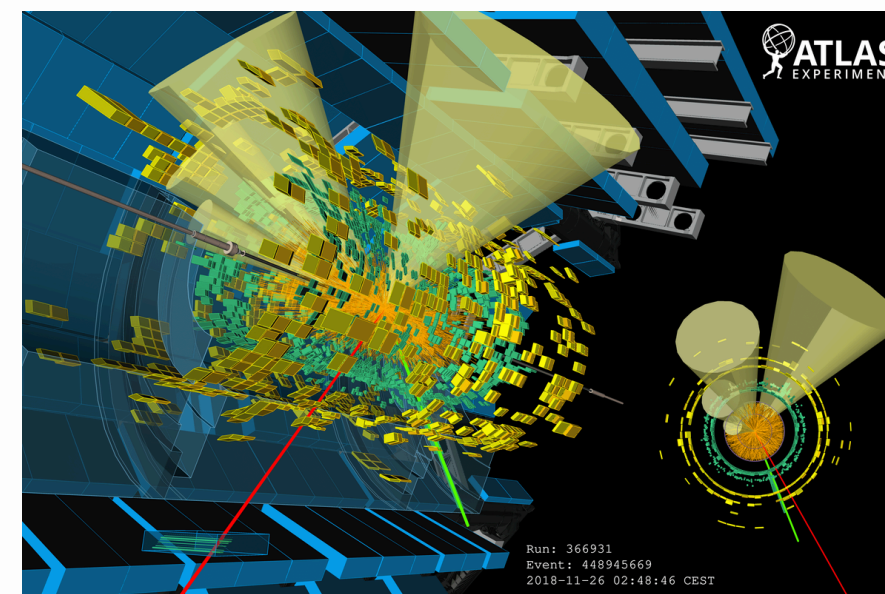
Webpage

Proton-Proton Collisions



13 TeV Proton-Proton collision datasets, 36 fb⁻¹, 2015–2016, 65 TB in PHYSLITE files, with 2 billion events of simulated data

Lead-Lead Collisions



5 TeV Lead-Lead collision datasets, 486 μb⁻¹, 2015, 4 TB in DAOD_HION14 files, with corresponding simulations

Coming soon

- **Event generation data** in HEPMC format
 - provided in 10,000 event text files, tarred and gzipped to save space, for both 13 TeV and 13.6 TeV configurations
- **Heavy ion data** from the hard probes stream with corresponding simulations

ATLAS OPEN DATA Website

High Energy Physics data for everyone.

For Education

To provide data and tools to high school, undergraduate and graduate students, as well as teachers and lecturers, to help educate them and exercise in physics analysis techniques used in experimental particle physics.

For Research

To provide researchers with high-quality data recorded by the ATLAS detector, enabling them to conduct state of the art analyses in particle physics.

Get Started

Our values

The collaboration shares the data gathered by the ATLAS detector committing to three fundamental principles:

Accessibility

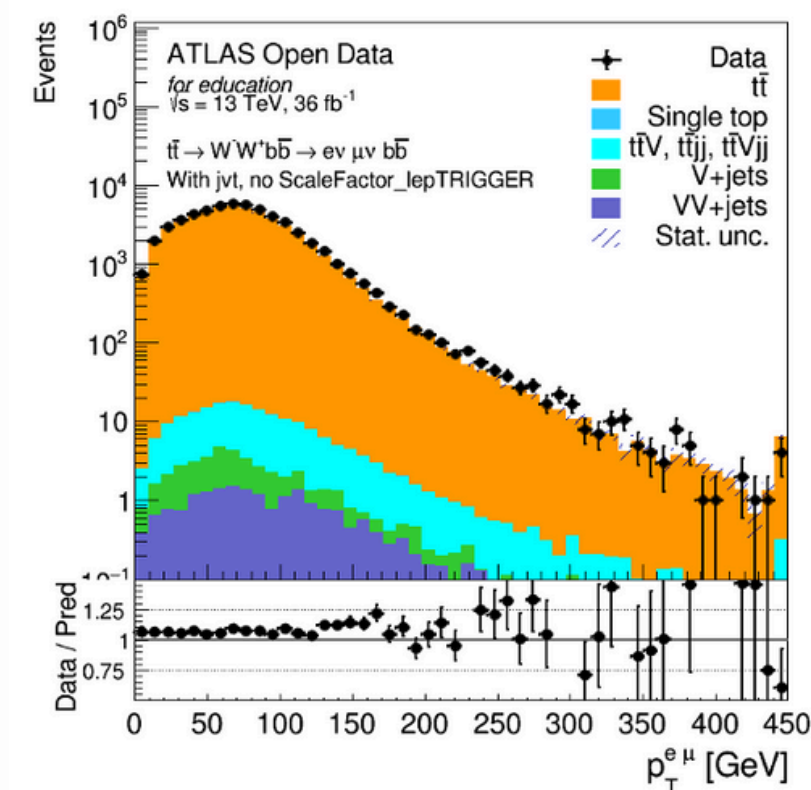
Make the data and the tools openly available for everyone to use, without technology, region, or knowledge restrictions.

Transferable expertise

Along with particle physics analysis and ATLAS learning objectives, provide skills in programming, software and machine learning.

Usability

Different target audiences, with different backgrounds and skills must be able to use the data and tools for a wide range of learning objectives.



Datasets on
CERN Open
Data Portal
including first
and second
releases.

For Education Webpage

Fully accessible website with step-by-step tutorials, tools, videos, data visualisation (Histogram Analyser, Machine Learning online application, teacher workshop, Jupyter Notebook analyses, and analysis facilities.

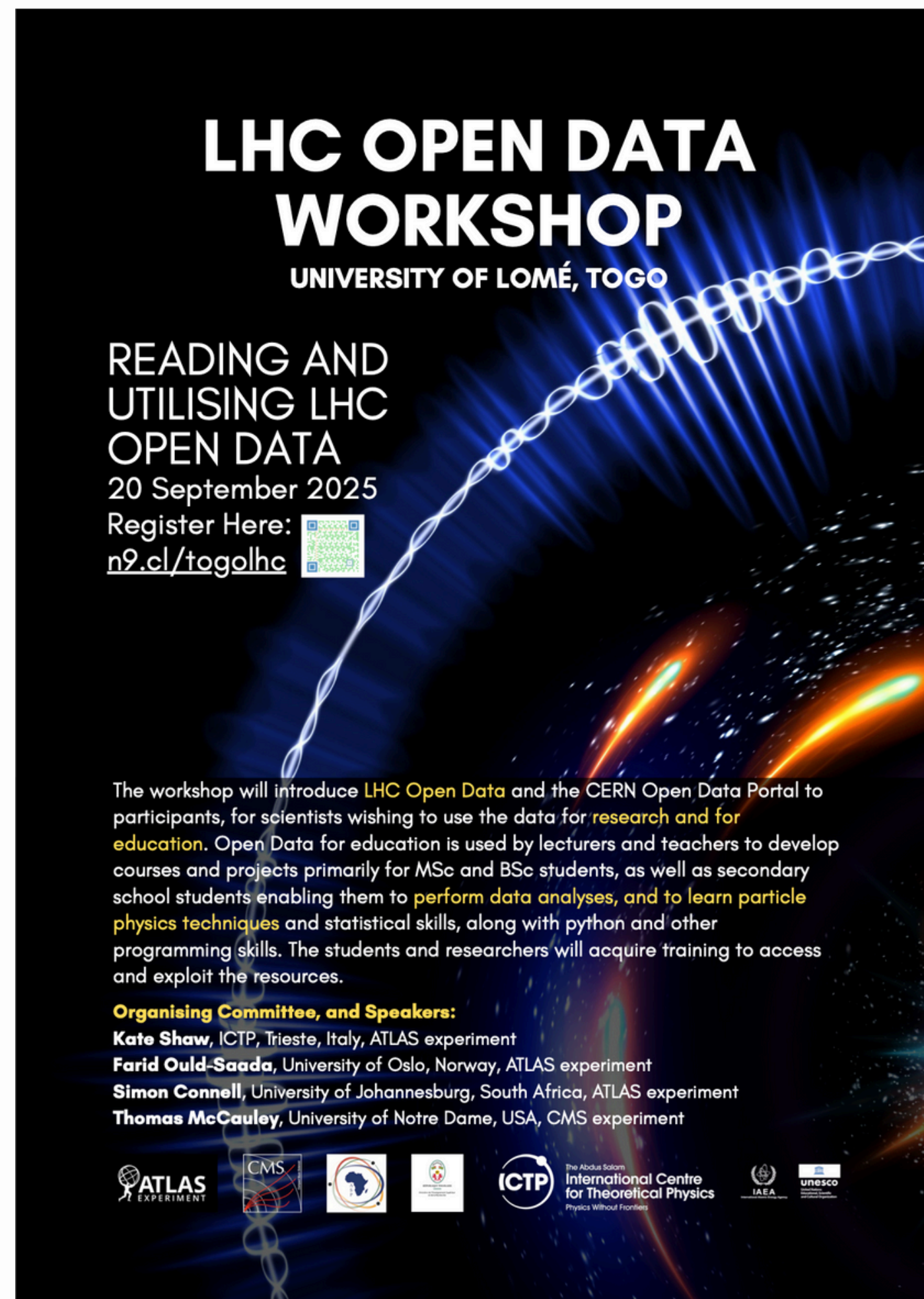
OPEN DATA: How is it used?

Theorists/ scientists wanting to do studies

PhD training, undergraduate courses and BSc and MSc projects


- Students can dive into the learning objectives immediately (physics, statistics, analysis skills such as fitting and machine learning);

Training and **outreach** activities such as **hackthons** and **workshops**, with PhD students, university students, 16–18 year olds or even younger

The poster features a dark blue background with a glowing blue particle track (resembling a helix) and streaks of orange and yellow light. The text is white and yellow. At the top, the title 'LHC OPEN DATA WORKSHOP' is in large white letters, followed by 'UNIVERSITY OF LOMÉ, TOGO' in smaller white letters. Below this, the text 'READING AND UTILISING LHC OPEN DATA' is in white, followed by the date '20 September 2025' and the registration link 'n9.cl/togolhc' next to a QR code. A paragraph of text describes the workshop's purpose. Below that, the 'Organising Committee, and Speakers:' section lists four names and their affiliations. At the bottom, there are logos for ATLAS, CMS, IAEA, UNESCO, and ICTP.






LHC OPEN DATA WORKSHOP

UNIVERSITY OF LOMÉ, TOGO

READING AND
UTILISING LHC
OPEN DATA
20 September 2025
Register Here: n9.cl/togolhc 

The workshop will introduce **LHC Open Data** and the CERN Open Data Portal to participants, for scientists wishing to use the data for **research and for education**. Open Data for education is used by lecturers and teachers to develop courses and projects primarily for MSc and BSc students, as well as secondary school students enabling them to **perform data analyses, and to learn particle physics techniques** and statistical skills, along with python and other programming skills. The students and researchers will acquire training to access and exploit the resources.

Organising Committee, and Speakers:
Kate Shaw, ICTP, Trieste, Italy, ATLAS experiment
Farid Ould-Saada, University of Oslo, Norway, ATLAS experiment
Simon Connell, University of Johannesburg, South Africa, ATLAS experiment
Thomas McCauley, University of Notre Dame, USA, CMS experiment

     The Abdus Salam
International Centre
for Theoretical Physics
Physics Without Frontiers




Getting Started

We use [Matomo](#) to internally analyze traffic and help us improve your experience.; check [our privacy policy!](#)

 > [Get Started](#)

Get Started

In this section you will find different suggested paths to get involved with ATLAS Open Data. This are just suggestions on what we think it will be more usefull to check in each case. However, feel free to check the website freely.

 **Quick start**

The quickest way to start learning with ATLAS Open Data.

- No technical knowledge required
- Full introduction provided
- Step-by-step tutorials
- Instructions how to access data
- Histogram Analyser

[Get Started Webpage](#)

Histogram Analyser

Tool shows how physicists differentiate between physics processes applying cuts using just your mouse.

How to Separate Signals: Higgs to WW

Let's look at the simulated data.
Using the Histogram Analyser we can look at each sample separately and understand a little more about their characteristics. This will help us separate our signal from the background later.
Select the sample by clicking on the bar in the Expected Number of Events histogram.
The rest of the histograms now just display the characteristics of your chosen sample.

$$H \rightarrow W^+W^-$$

$$H \rightarrow W^+W^- \rightarrow \ell^+\ell^-\nu\bar{\nu}$$

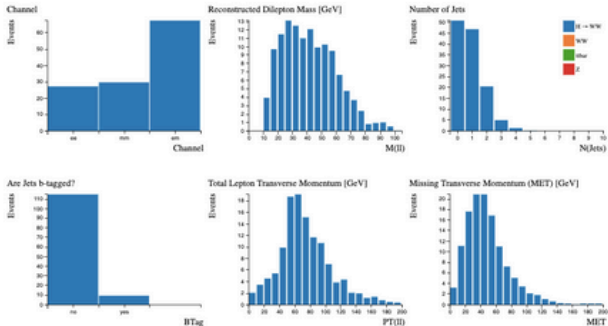
(ℓ = electron, muon)

Curriculum Learning Objective: Particle decay balancing with charge

[see e.g. OCR A-level physics 6.4.2]
Why does the higgs boson decay into particles whose charges sum to zero?

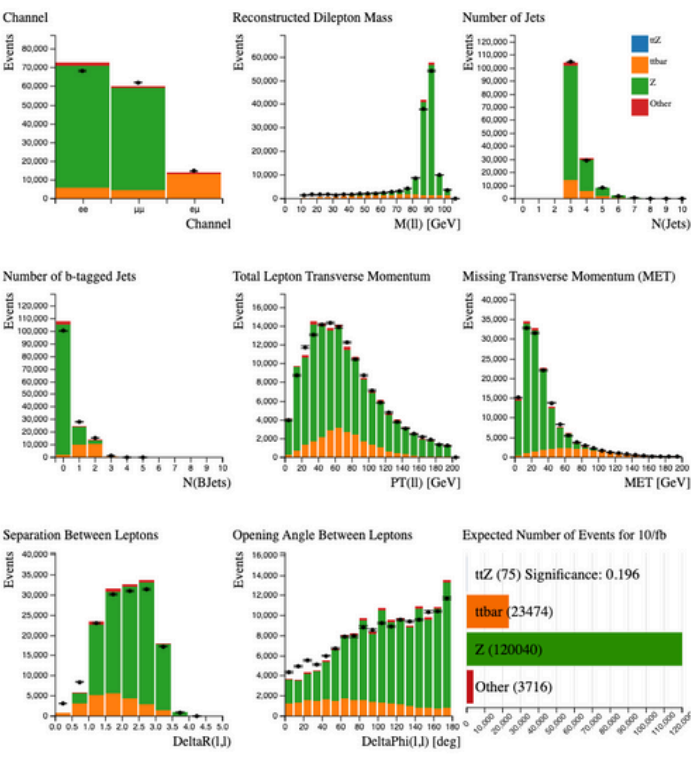
Curriculum Learning Objective: Classification of leptons

[see e.g. OCR A-level physics 6.4.2(d)]
Electron and muon channels are shown separately in the histograms.
Our signal is the Higgs boson which decays into two W bosons which subsequently decay into leptons and neutrinos.



The histograms explained

Histogram Analyser displays nine histograms. The description of each follows.
The histograms can take about 30 seconds to load. Whilst loading you'll only see the histogram titles. Once loaded you'll see the histograms appear under their titles.
We think it really helps to be able to see all nine histograms on your screen at the same time. So if this isn't the case to start with, we suggest decreasing the zoom in your web browser until you can see all nine (e.g 67%).

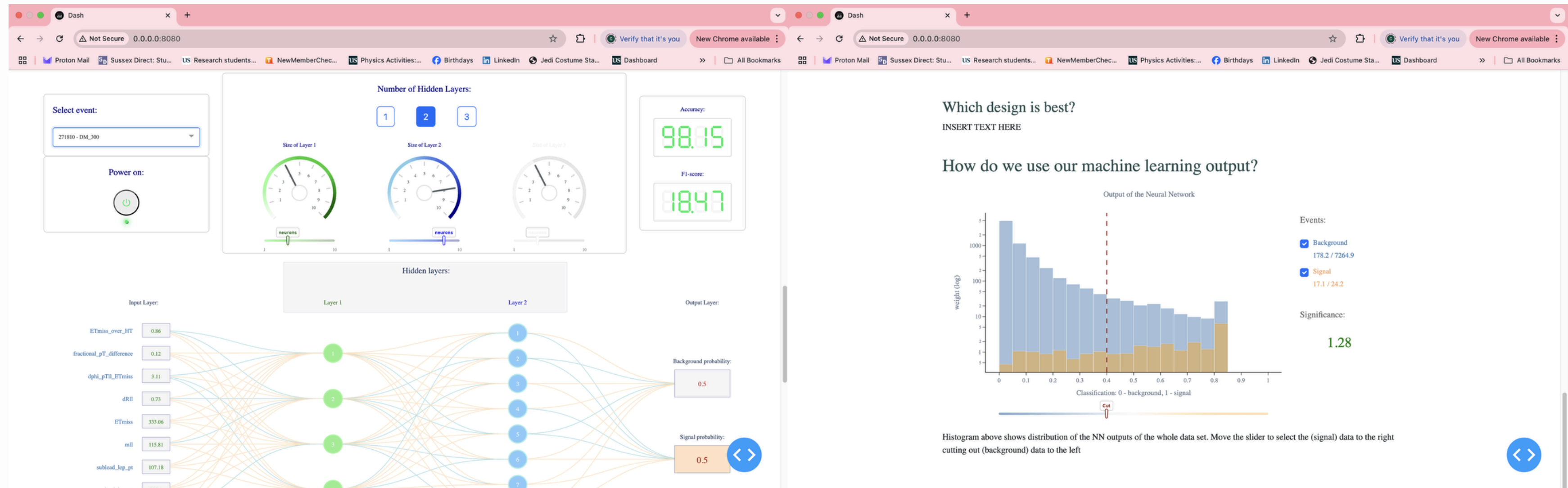


You can select just the $t\bar{t}Z$ events by clicking on the $t\bar{t}Z$ in the 'Expected Number of Events' histogram.

Machine Learning Online Interactive Application

- Machine Learning tutorial using only your mouse!!
- <https://ml-visual-dashboard-atlas-open-data.app.cern.ch/>
- Run a Neural Network to discover Dark Matter!

NEW



Teacher workshop

Welcome to ATLAS Open Data in the Classroom



[Webpage](#)

An application to facilitate the learning of useful experimental particle physics techniques

Available in languages:
English, Spanish, Italian

Google Chrome

ATLAS Open Data in the Classroom

▶ Getting Started

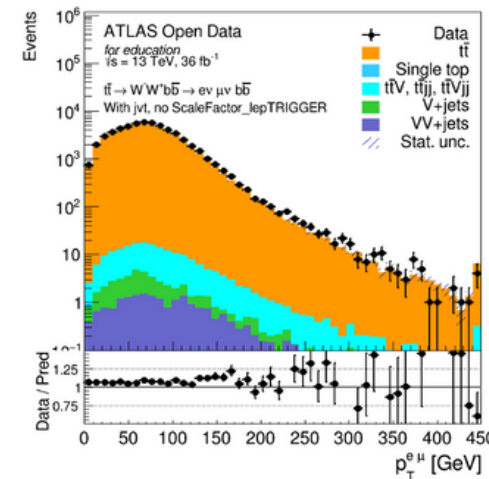
- ▶ Foundations of Particle Physics
- ▶ Experimental Particle Physics
- ▶ Analyze ATLAS Open Data
- ▶ Intro to Python
- ▶ Classroom Toolkit

Advanced Tutorials

Jupyter Notebooks

Uproot

Higgs to ZZ **NEW**



This notebook uses the 2025 release of the ATLAS Open Data to show you to rediscover the Higgs boson yourself! You will discover the Higgs boson into a pair of Z bosons, which are in turn decaying into a lepton-antilepton

Physics: ★

Coding: ★★

Time: ★★★

[launch](#) [binder](#) [Open in Colab](#)

Higgs to $\gamma\gamma$ analysis **NEW**

This notebook uses the 2025 release of ATLAS Open Data, with 36.1 fb^{-1} ,

Jupyter Notebooks

Developing of online tutorials:

Jupyter notebooks analyses (with & without ROOT framework), in C++, pyROOT 8 TeV and 13 TeV & uproot.


Different frameworks available to suit different learning objectives and use cases:

- Python
- C++
- RDataFrame
- Uproot / Coffea
-

All Notebooks are available on the GitHub repository.



ATLAS Open Data Videos on YouTube



FIND THE HIGGS

OPEN DATA TUTORIAL

ATLAS Open Data Tutorials


by ATLAS Experiment

Playlist • 8 videos • 4,280 views

Video tutorials explaining different ways to use Open Data from the ATLAS Experiment at CERN.

Play all

- 1




FIND THE HIGGS

OPEN DATA TUTORIAL

17:18

Find the Higgs boson with your mouse – ATLAS Open Data Tutorial

ATLAS Experiment • 3.3K views • 4 years ago
- 2




INTRO TO JUPYTER

OPEN DATA TUTORIAL

4:26

Data analysis in a web browser – ATLAS Open Data Tutorial

ATLAS Experiment • 1.9K views • 4 years ago
- 3




ANALYSE THE HIGGS

OPEN DATA TUTORIAL

9:57

How to rediscover the Higgs boson – ATLAS Open Data Tutorial

ATLAS Experiment • 3.2K views • 4 years ago
- 4




INSTALLING VIRTUALBOX

OPEN DATA TUTORIAL

3:35

Installing a VirtualBox - ATLAS Open Data Tutorial

ATLAS Experiment • 700 views • 4 years ago
- 5




INSTALL A VIRTUAL MACHINE

OPEN DATA TUTORIAL

9:47

Installing a Virtual Machine - ATLAS Open Data Tutorial

ATLAS Experiment • 1.5K views • 4 years ago
- 6




MAKE SELECTION CUTS WITH PYROOT

OPEN DATA TUTORIAL

10:06

Making Selection Cuts with PyROOT – ATLAS Open Data Tutorial

ATLAS Experiment • 1.8K views • 3 years ago
- 7



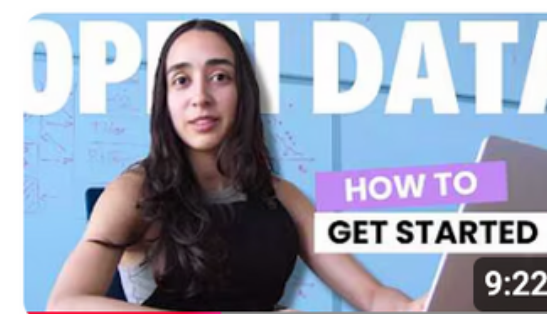
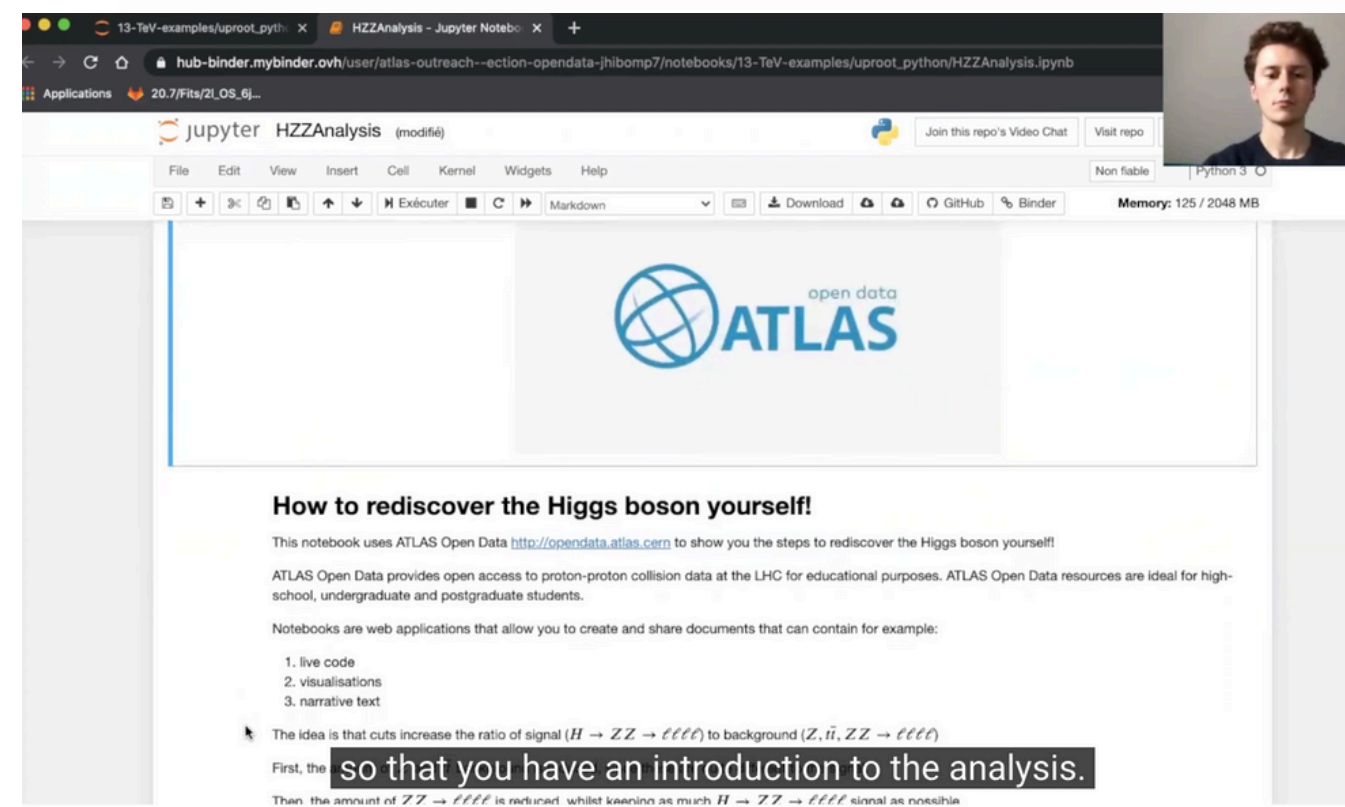
CREATE HISTOGRAMS WITH PYROOT

OPEN DATA TUTORIAL

9:18

Create Histograms with PyROOT – ATLAS Open Data Tutorial

ATLAS Experiment • 2.5K views • 3 years ago



Getting Started with ATLAS Open Data

ATLAS Experiment • 2.1K views • 1 year ago

[Find the videos here](#)

Summary

EDI is such an important part of building our community, we all must invest in supporting initiatives, and support the **international** community

Outreach and **Open Data** is an important part of our experiments deliverables, for research and education, to build trust and help secure support

Get in touch with your **collaboration EDI** team or **outreach** team, many resources out there.



Mark Thomson, CERN's new Director General

Pillars 3 & 4

Pillar 3 (Value for CERN's stakeholders), where the main priorities will be

- **Improve the balance of return to CERN's Member States and Associate Member States**
 - At a time when we will soon be seeking approval for FCC-ee, this is **absolutely essential**, we will need the strong support of our member states
 - We need to achieve balance in both "industrial return" and "personnel return"
- **Strengthen our relations with the EU and other key partners**
 - Including Canada, Japan and the US, as well as with other laboratories in CERN's member states
- **Continue to collaborate with neighbouring scientific fields within resource constraints**
 - We will prioritise existing commitments and activities that support of CERN's other strategy goals
 - Including projects important to European Science and our Member States, e.g. Einstein Telescope

Pillar 4 (Wider impact), with main priorities to

- **Inspire the next generation**
- **Support the European technological landscape**
- **Further increase the impact of CERN's KT activities**



European Strategy for Particle Physics

Talk from the Open Symposium on the European Strategy for Particle Physics

General guiding principles

Outreach and Communication

- Strengthen public trust in science through outreach that fosters critical thinking, counters misinformation, and inspires future scientists.
- Shift science communication from scientific discoveries to research processes, personal stories, and the value of international collaboration and DEI.
- Expand outreach to diverse and underrepresented audiences to boost interest in STEM. Use social media to ensure a broad reach.
- Communicate effectively and transparently to build public and political support for the next European flagship project.

Training and Education

- Strengthen training in instrumentation (and thereby support a timely execution of the ESPP).
- Establish closer ties with industry.
- Integrate modern physics into school curricula.

Open Science

- Promote Open Access to scientific knowledge.
- Encourage the use of Open Data in education, outreach, and citizen science.

WG6 Composition

- M. Bombara (Slovakia)
- M.J. Costa (Spain)
- L. de Paula (Brazil)
- S. Özkorucuklu (Türkiye)
- M. Pimenta (Portugal)
- P. Van Mechelen* (Belgium)
- L. Zivkovic (Serbia)

* chair