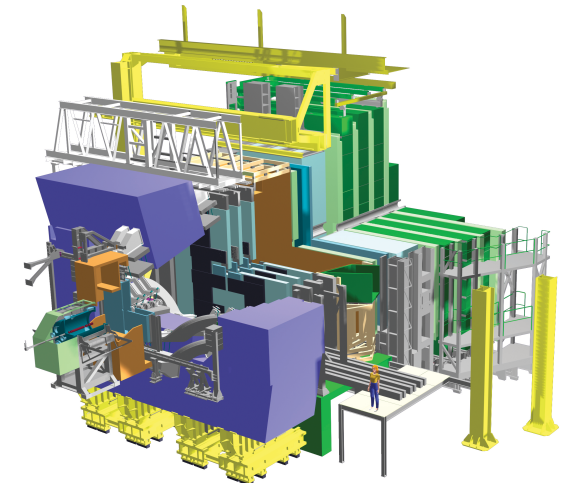
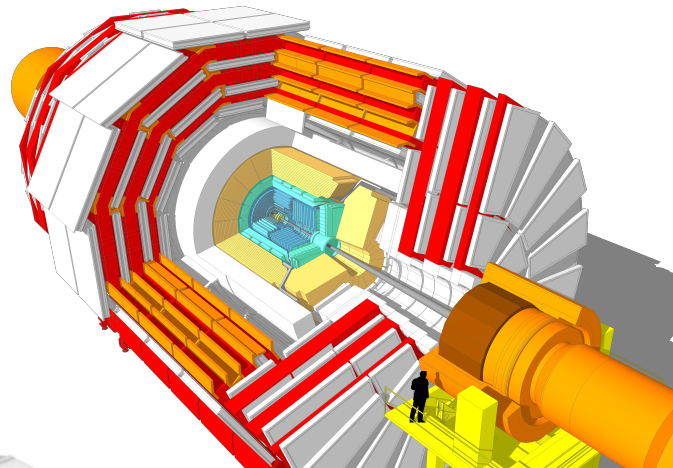
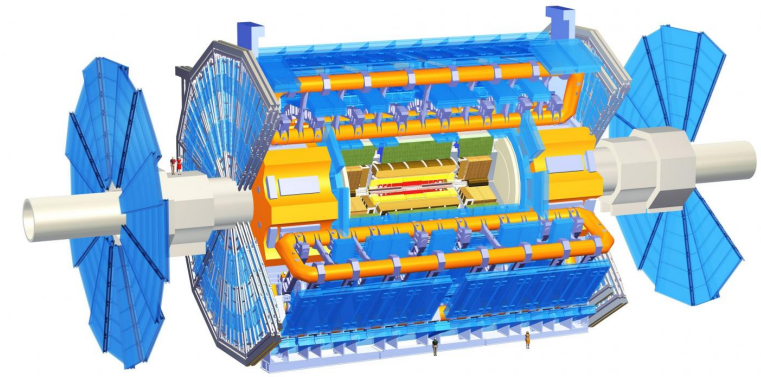
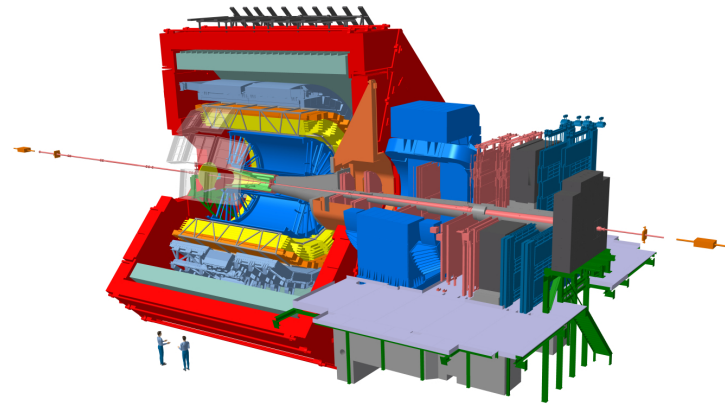


Outreach at the LHC



V. Bellée on behalf of the
ALICE, ATLAS, CMS and
LHCb collaborations

6 June 2021

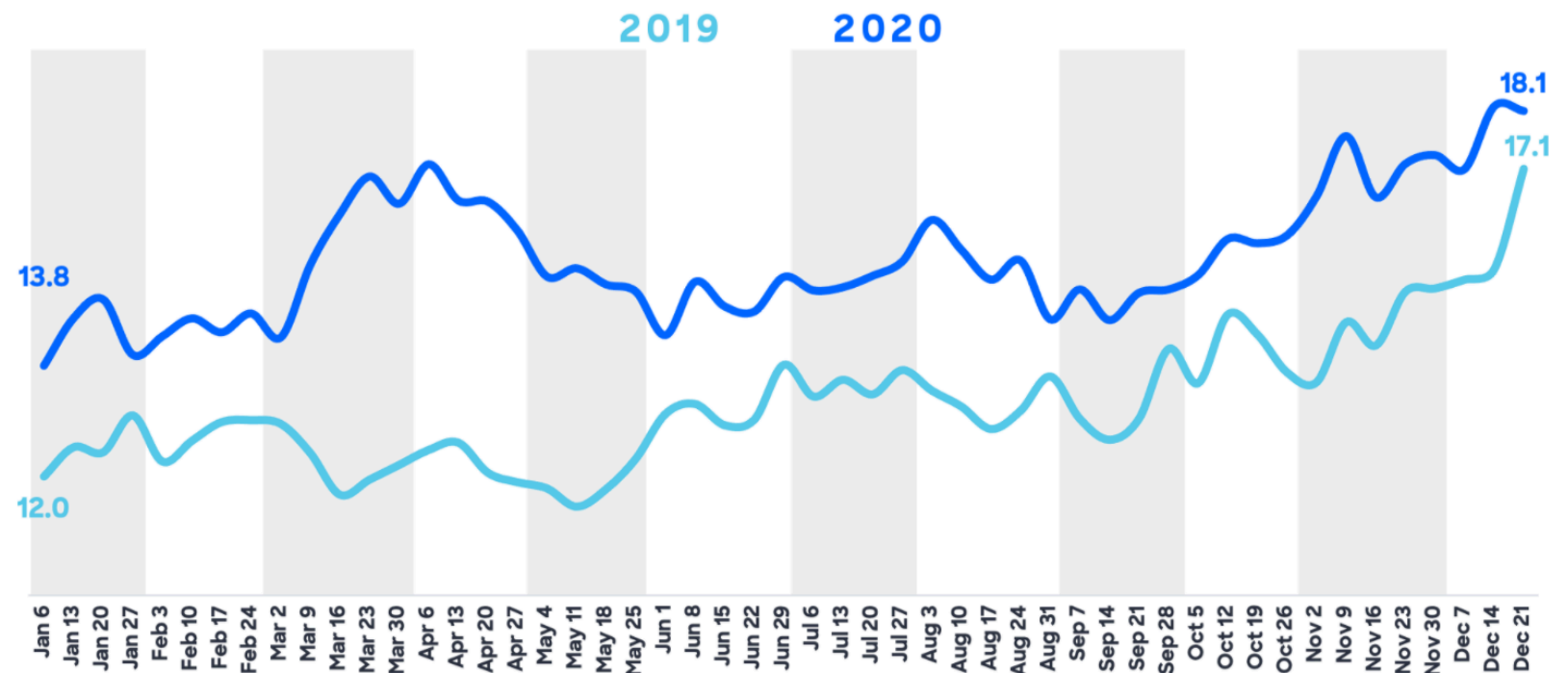


**Universität
Zürich**^{UZH}

LHCP 2021 Paris Sorbonne@home

- ▶ Outreach activities in the experiments seriously **hit by the pandemic**:
Onsite visits and travels not possible anymore
- ▶ In **2020, online boom**: drastic increase of in-home data usage due to confinements (implying staying at home, teleworking and homeschooling)
In the US, total in-home data usage increased by 18% between 2019 and 2020
- ▶ Experiments have adapted their outreach activities by:
 - ▶ **Changing previously existing activities** to fully-online modes
 - ▶ Developing **totally new outreach activities**

Average total daily in-home data usage across common devices in the US (GB received)



Source: [Comscore Total Home Panel Custom Reporting](#)

**GOING VIRTUAL
AND LIVE**

**OUTREACH
2020–2021**

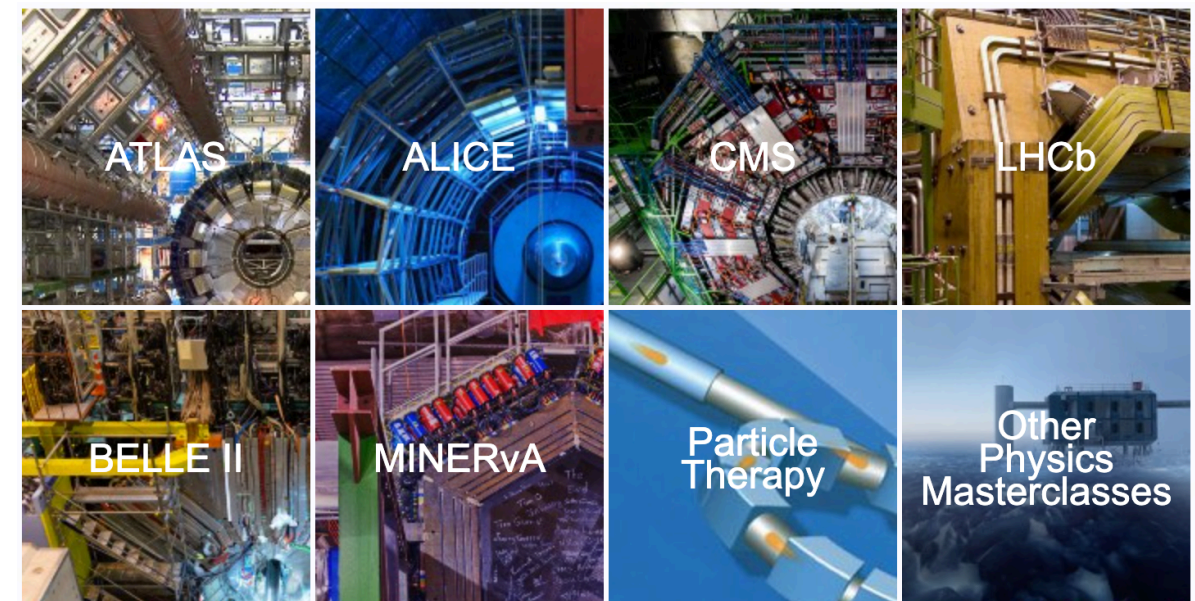
**RELEASING
NEW ONLINE
MATERIAL**

**COMMUNICATING
ONLINE**

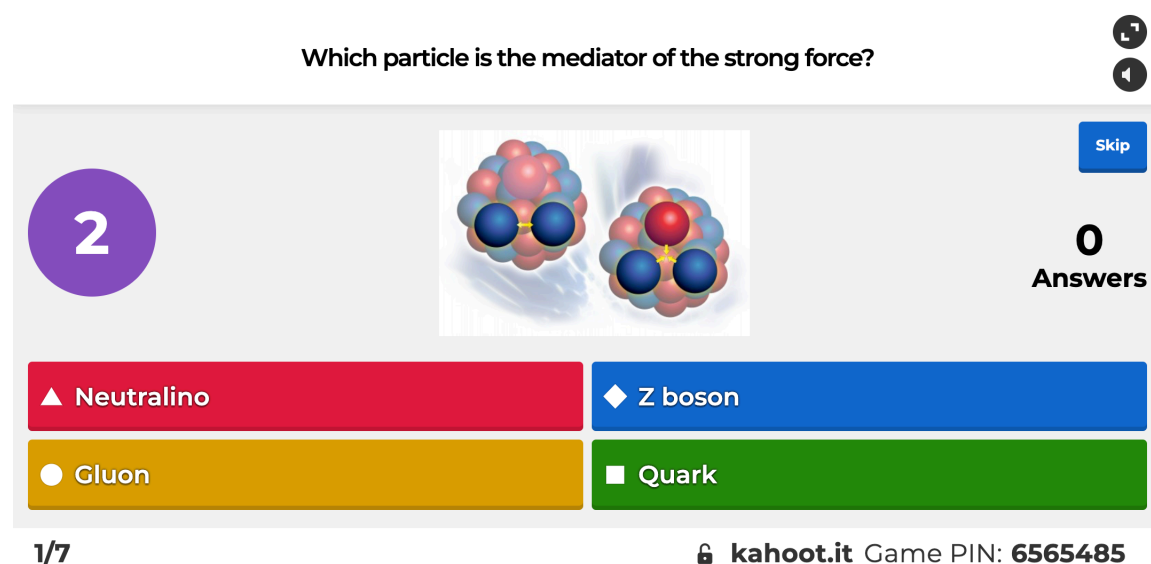
**GOING VIRTUAL
AND LIVE**

**OUTREACH
2020–2021**

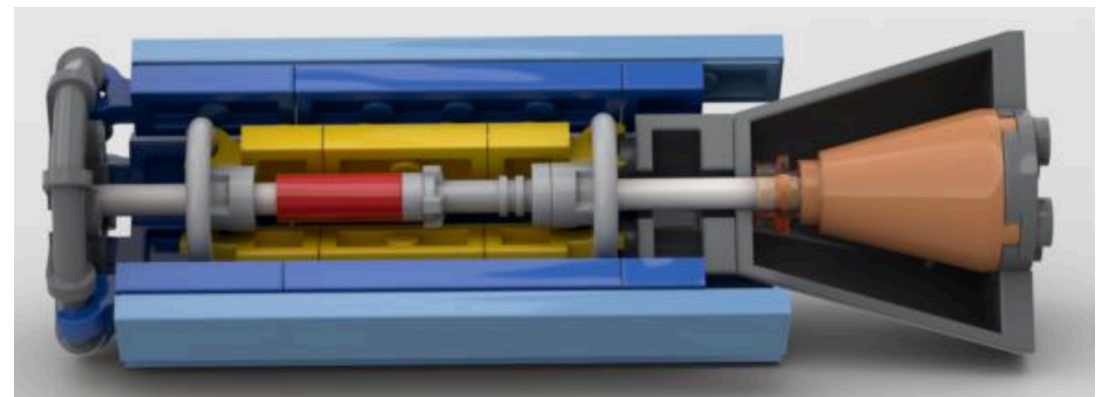
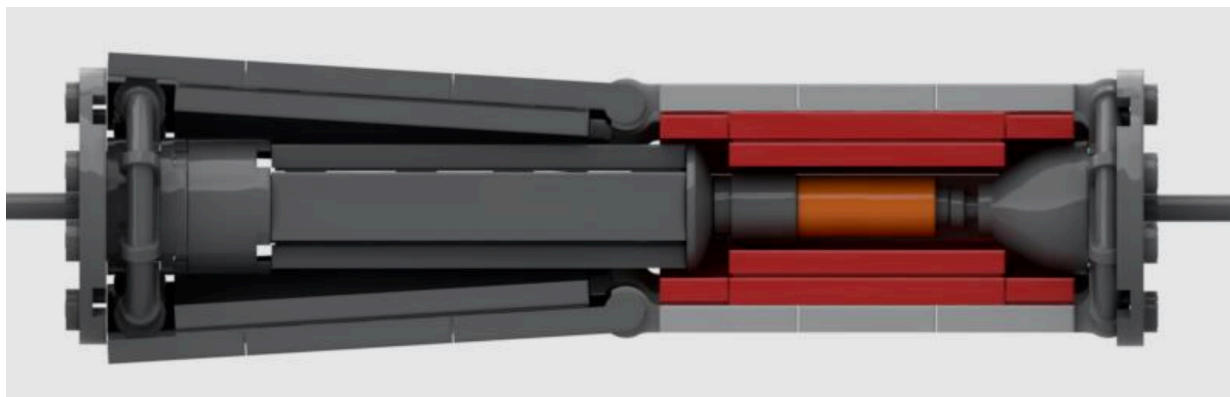
- ▶ Strong participation of the four experiments in the [International Masterclasses](#) (Feb-Mar 2021)
- ▶ Targets **high school students** who “become physicists for one day” (with courses, exercises and discussions)
- ▶ New tools to switch to fully virtual mode:
 - Use of **Zoom webinars**
 - **Quiz using [Kahoot](#)**



- ▶ In 2020, International Masterclasses had 1/3 of the attendance of 2019. But **in 2021, attendance increased** to 50% of that amount, with students coming from **more remote locations**
- ▶ **Special masterclasses** were also organised on specific occasions, e.g. [special ALICE masterclasses for girls](#) in India, Czech Republic and Greece (for the International Day of Women and Girls in Science)

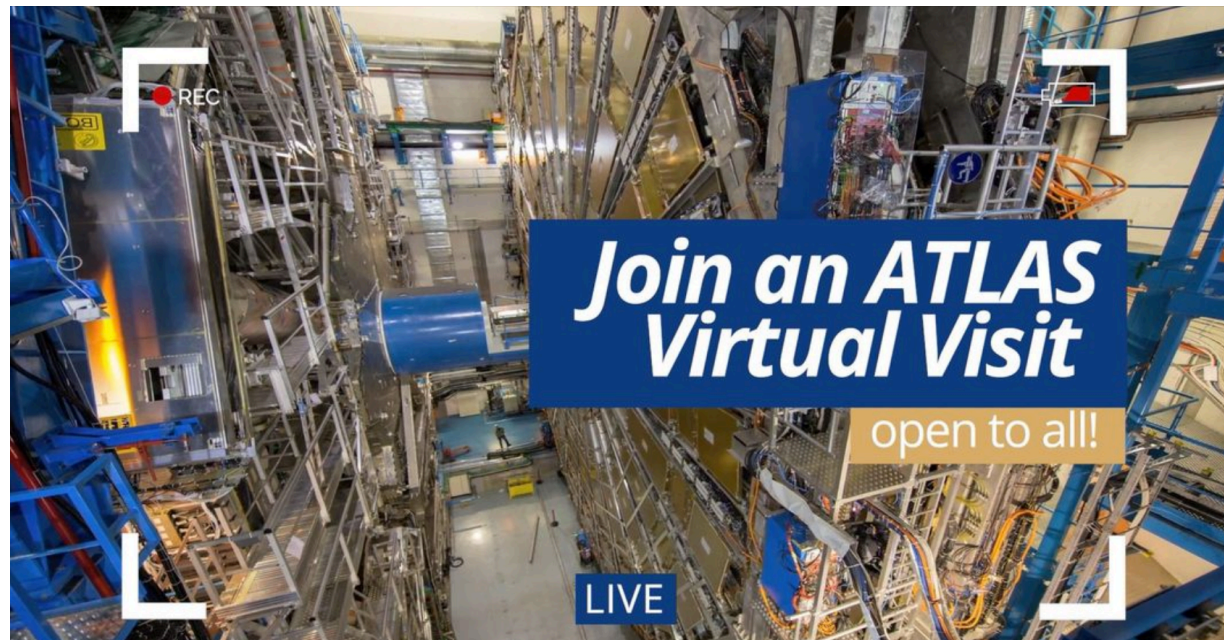


- ▶ Workshop organised in Germany to **design** and **build a LEGO model of the ALICE detector** (to be displayed in the ALICE surface exhibition and reused in future outreach events)
 - Similar models already exist for ATLAS and CMS
- ▶ **Students from 15 yo to 3rd year University** propose designs in teams and then choose between them
- ▶ **Online** workshop over 6 months, except construction over three days scheduled in June 2021 (**stay tuned!**)



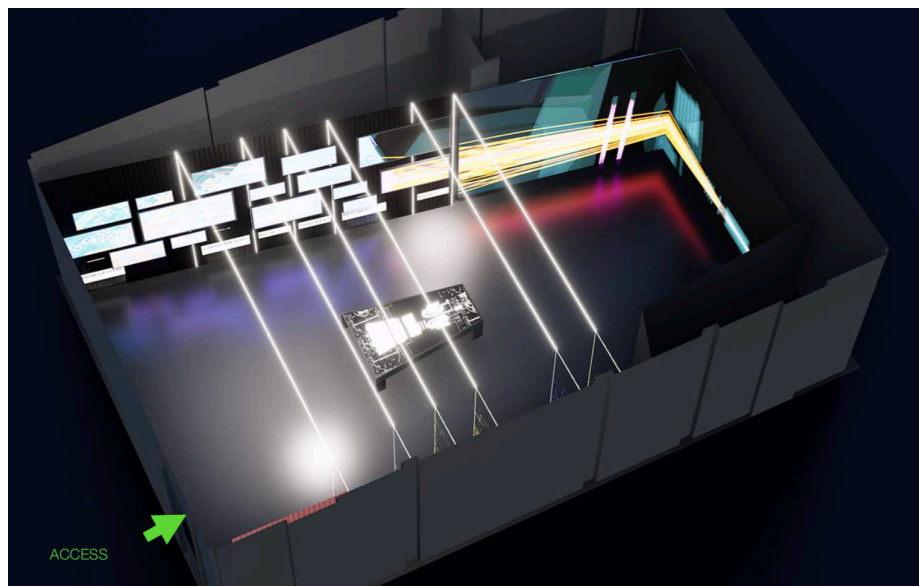
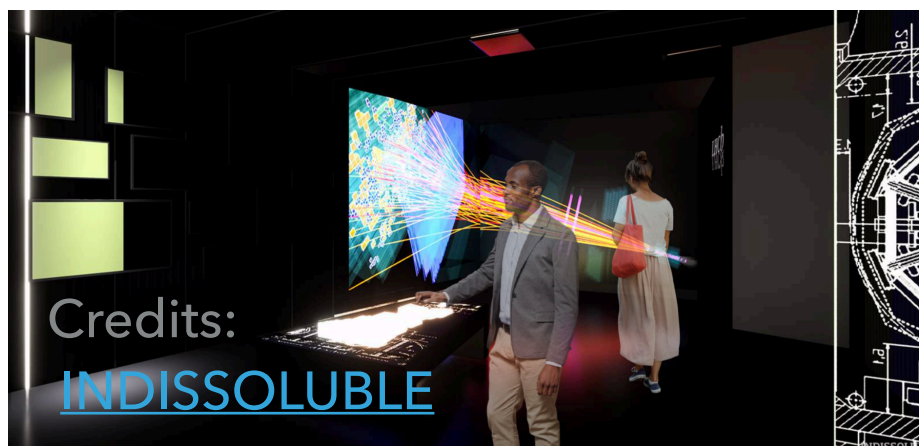
Proposed LEGO designs for the ALICE Inner Tracking System (Credits: [M. Mikorski](https://www.mikorski.com))

- ▶ Onsite visits stopped: A programme of **virtual visits** started or scaled up in all experiments, with **different formats**



- ▶ ATLAS and CMS both have a **long standing history of virtual visits** which was efficiently pursued in the last year:
 - ATLAS organised 34 [group virtual visits](#) in 2020 and 66 in 2021, and started organising [open virtual visits](#)
 - CMS members guided 27 [group virtual visits](#) in 2020 and 28 in 2021

- ▶ ALICE acquired **dedicated mobile equipment** for virtual visits this year
 - **quickly scaled up** with thousands of participants in group virtual visits last year
 - since March 2021, seven [ALICE Open visits](#) guided in English, French and Italian



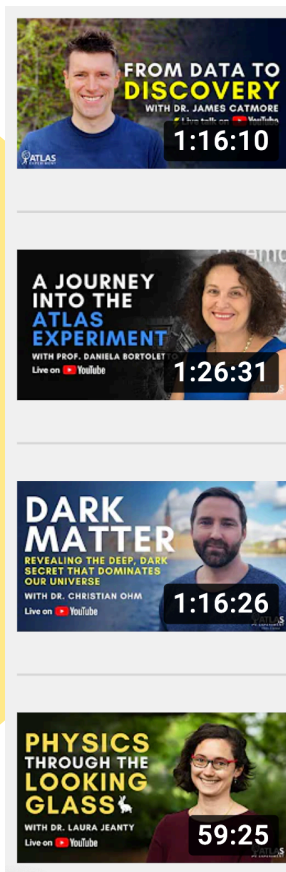
MAR., 1 JUIN

ALICE Open Virtual Visit

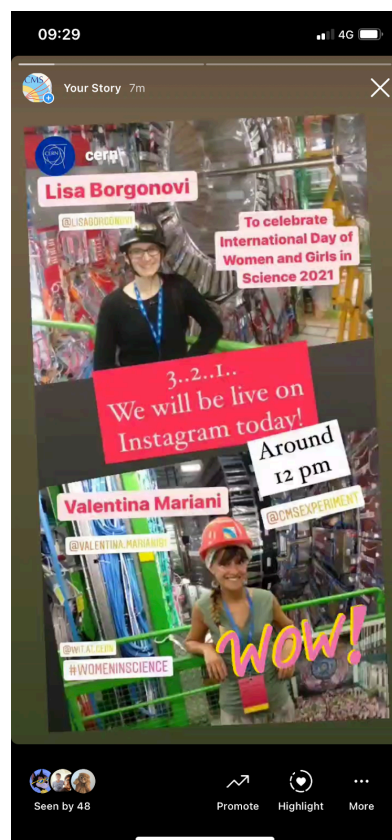
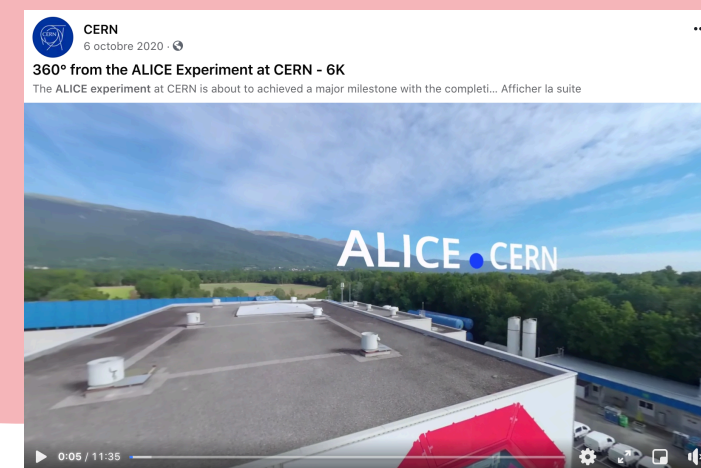
Maison · 155 personnes

- ▶ LHCb has started organising internal virtual visits (CERN and LHCb newcomers), plans to acquire equipment and organise public visits in the next year
 - Preparing for re-opening: In 2020, **wholesale redesign of the LHCb surface exhibition** with an immersive multimedia show

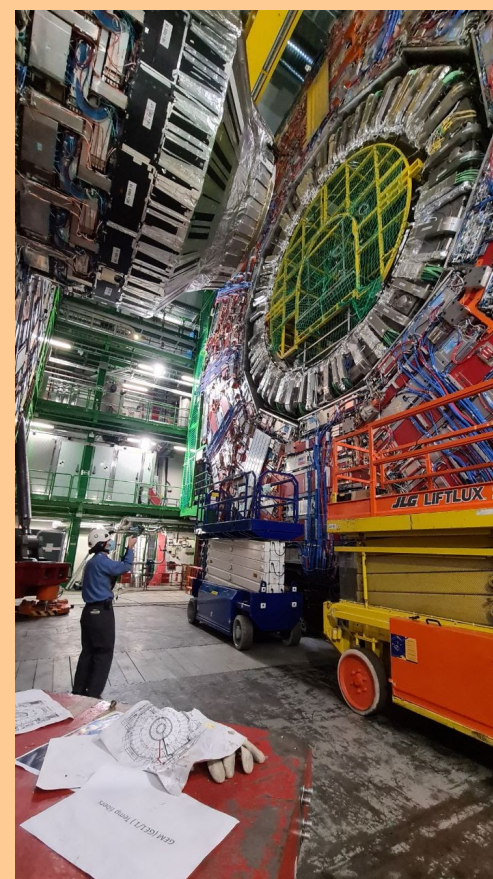
- ▶ **Live talks about particle physics @ ATLAS**, broadcast on a new Youtube channel:
[Live on Youtube: Learn about Particle Physics](#)



- ▶ On 25th Sep 2020: [360° youtube/facebook live event](#) from the **ALICE cavern** (on the occasion of the reinstallation of the upgraded ALICE TPC)



- ▶ On 11th February 2021: **Live@CMS** on Instagram for the International Day of Girls and Women in science (CERN/INFN)

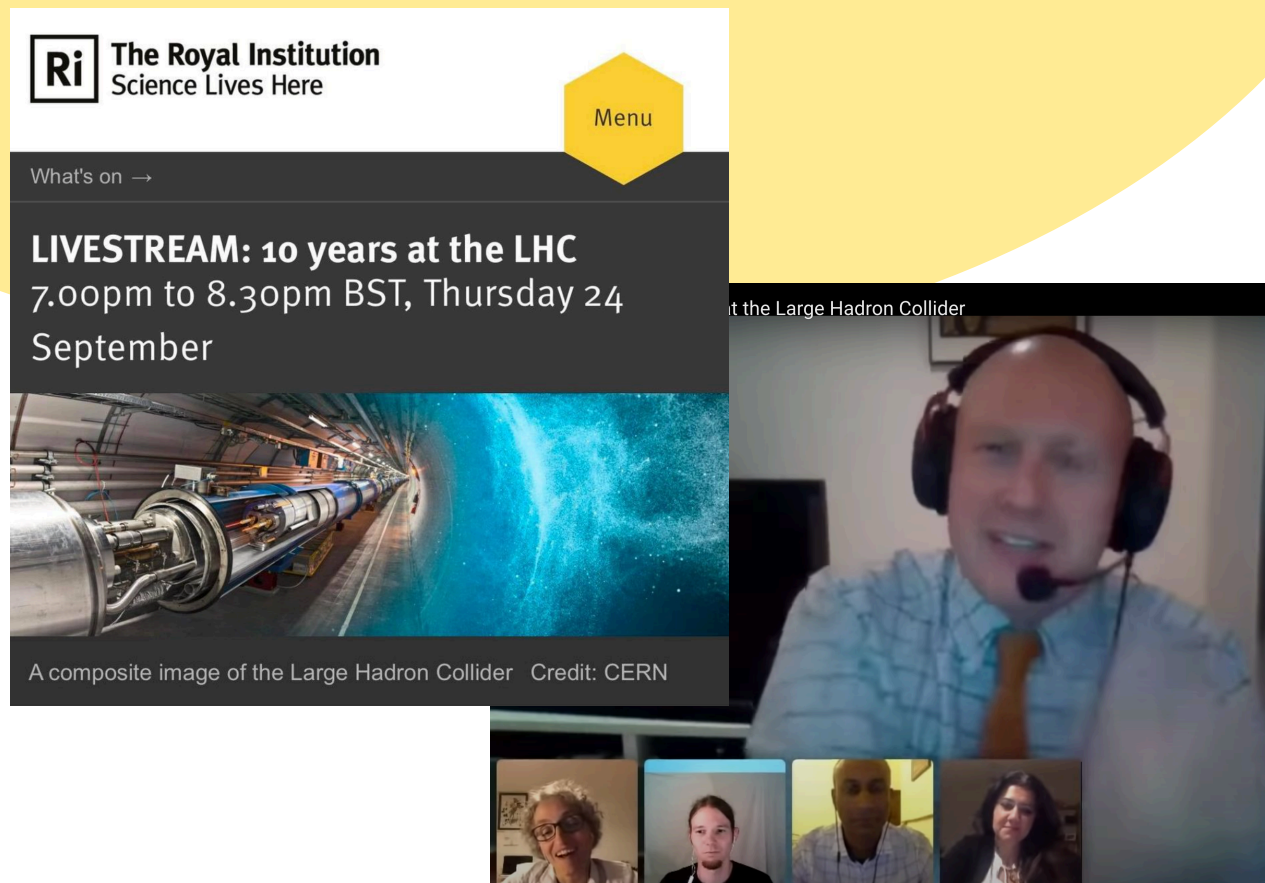


- ▶ On 27th Nov 2020: **Virtual visits of CMS for the Researchers nights** in 5 countries ([Brazil](#), [Hungary](#), [Italy](#), [Portugal](#), [Spain](#))

GOING LIVE: ONLINE LIVE EVENTS WITH SEVERAL EXPERIMENTS

10

- ▶ 24th Sep 2020, **10 years at the LHC: Online panel event with the four LHC experiments** hosted by the Royal Institution in the UK
- ▶ One speaker from each experiment, broadcast live (~thousands of viewers) and with [recording on Youtube](#) afterwards (49k views)



- ▶ 30th Oct 2020, **Dark Matter Day @ CERN**: Two hours live event with YouTube and Facebook live discussions
- ▶ ATLAS and CMS provided two Dark Matter Hunters each
- ▶ The day before: public talk on Dark Matter on ATLAS Youtube channel



**OUTREACH
2020–2021**

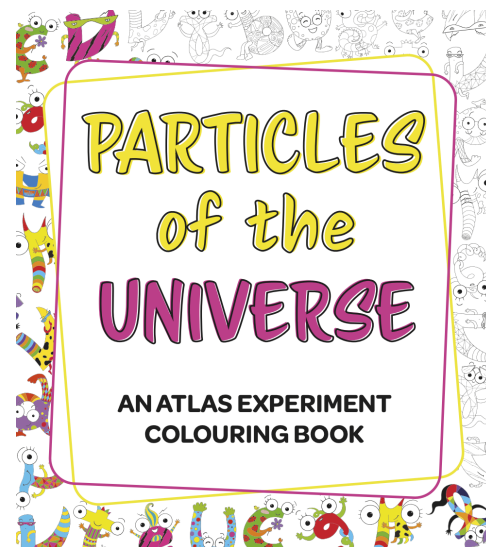
**RELEASING
NEW ONLINE
MATERIAL**

- Colouring books and activities **for young children** (mazes, puzzles) to **introduce the detectors and particle physics** while having fun!

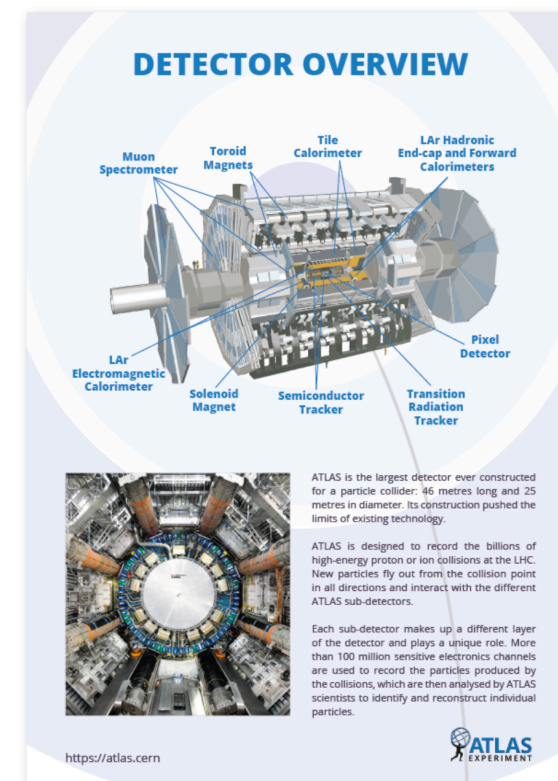


-THE ACTIVITY BOOK-

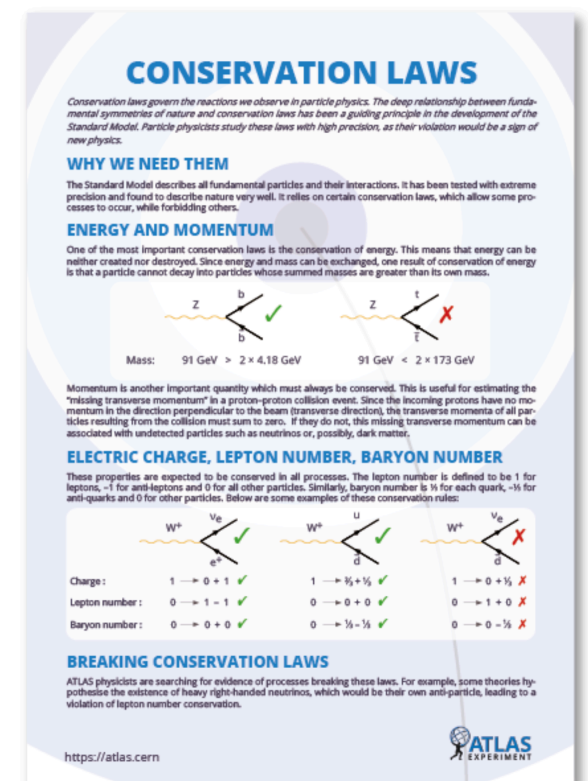
- New **colouring book and activities** at **ATLAS (2021)**



- New ATLAS "**fact sheets**" and "**cheat sheets**" giving **clear and concise (one page) information** about experiment-specific elements and physics terms used in the communication of physics results



Example fact sheet



Example cheat sheet

- ▶ The **public websites** of the collaborations gather outreach content and provide links to additional information (physics, detector, social media):
They are a **central place** where to look for information
- ▶ All have a section where **recent results are briefly explained**, avoiding jargon (LHCb: [Main public page](#), ALICE: "[Results](#)", CMS: "[Physics briefing](#)", ATLAS: "[Briefings](#)")

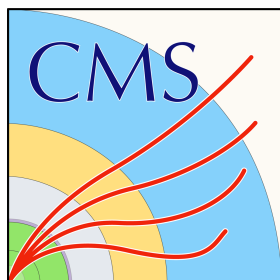


[LHCb public website](#)



ALICE

[ALICE public website](#)



[CMS public website](#)



[ATLAS public website](#)



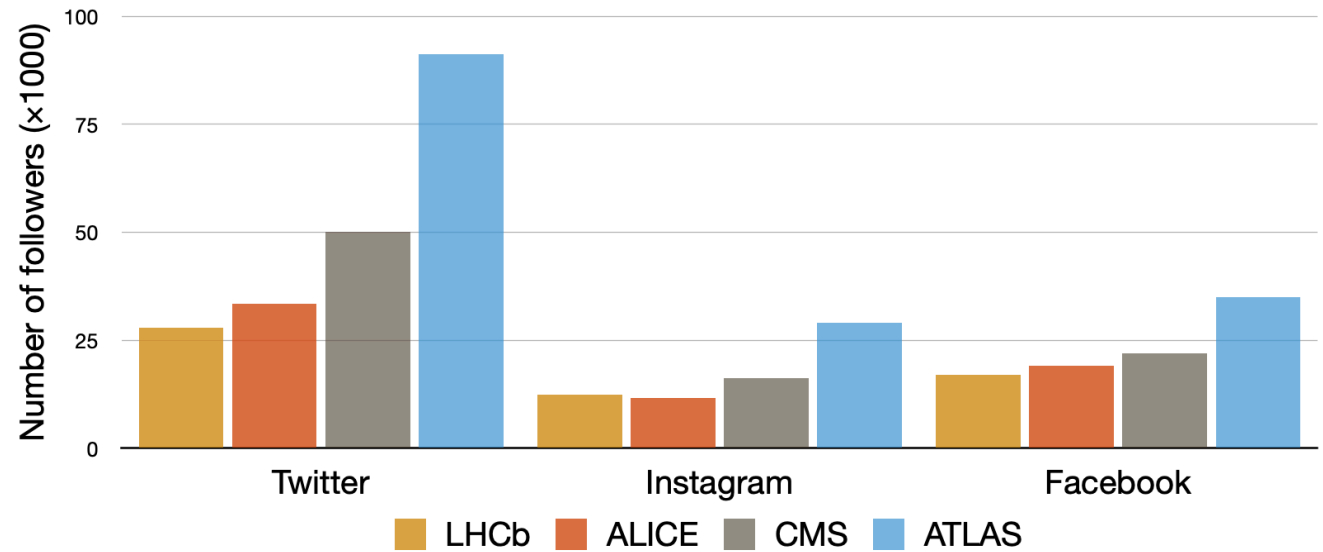
- ▶ Show the human beings behind physics:
The [ATLAS blog](#) and the [Cylindrical Onion blog](#) are where ATLAS and CMS members are able to share personal experiences

The background is a dark field filled with numerous thin, glowing orange lines that swirl and loop around. Two large, solid-colored circles are positioned in the center: a red one on the left and an orange one on the right, which overlap. The text is placed within these circles.

**OUTREACH
2020–2021**

**COMMUNICATING
ONLINE**

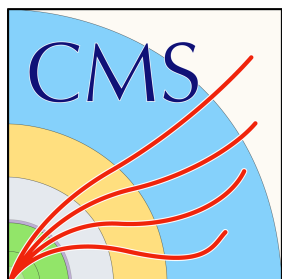
- All experiments make **heavy use of social networks** to communicate about news, upgrades, physics results and virtual visits to tens of thousands of followers



- [LHCb Experiment](#)
- [lhcbexperiment](#)
- [@LHCbExperiment](#)
- [@LHCbExperiment](#)



- [ALICE Experiment](#)
- [alice_experiment](#)
- [@ALICEexperiment](#)
- [@ALICE.experiment](#)



- [CMS Experiment](#)
- [cmsexperiment](#)
- [@CMSExperiment](#)
- [@CMSExperiment](#)



- [ATLAS Experiment](#)
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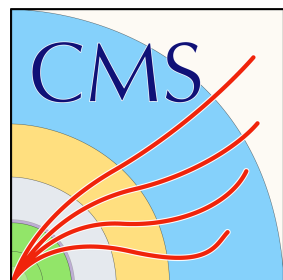
- Most viewed content on Youtube in the last year included **virtual visits, physics results** and celebration of the **Day of Women in Science**



[Link to the LHCb video](#)



[Link to the ALICE video](#)



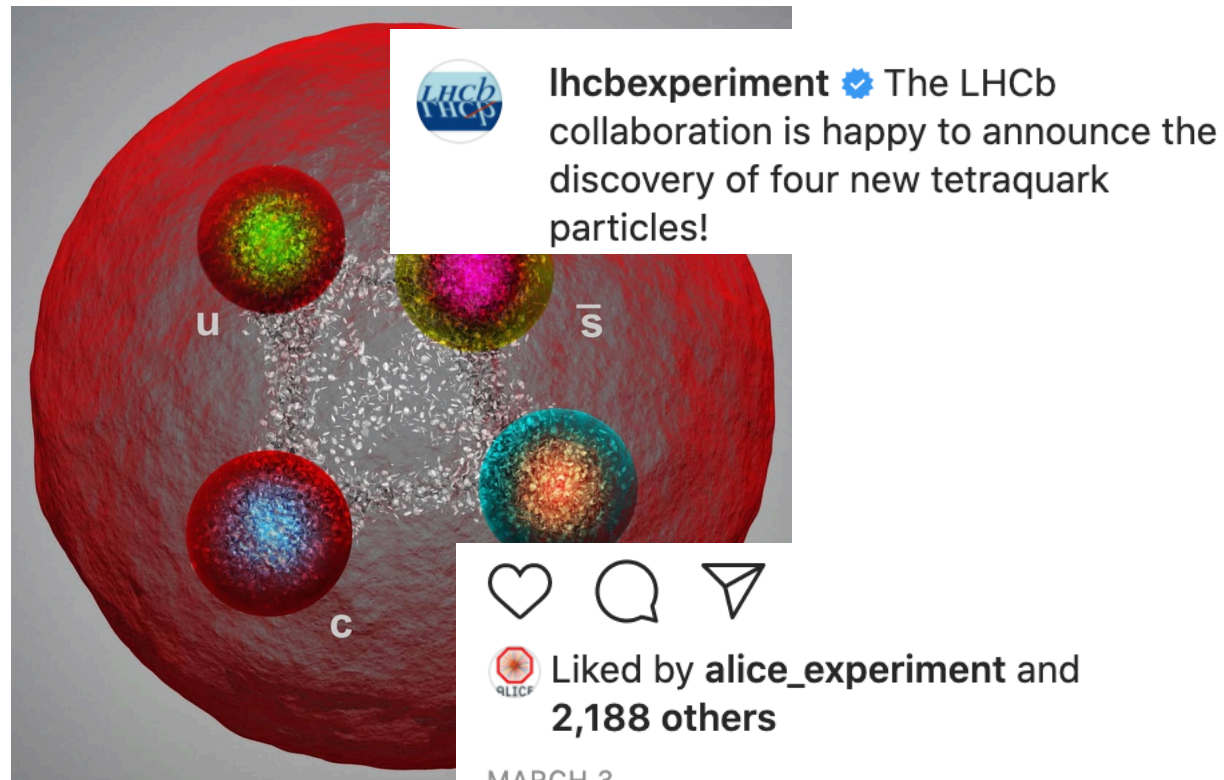
[Link to the CMS video](#)



[Link to the ATLAS video](#)



- ▶ This year, most liked content on Instagram is about **physics results**, announcement of **virtual visits**, **Higgs boson discovery day** and **detectors**



[LHCb tetraquark post](#)



[ALICE virtual visit post](#)

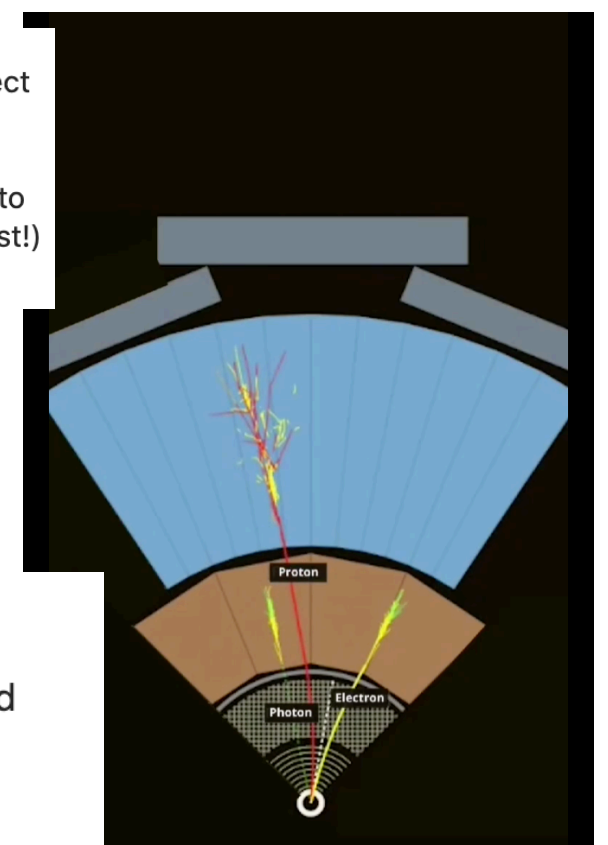


cmsexperiment Happy #HiggsBoson Day! #onthisday 8 years ago the amazing announcement made by CMS and @ATLASexperiment at @CERN!

[CMS Higgs post](#)



[ATLAS detector reel](#)



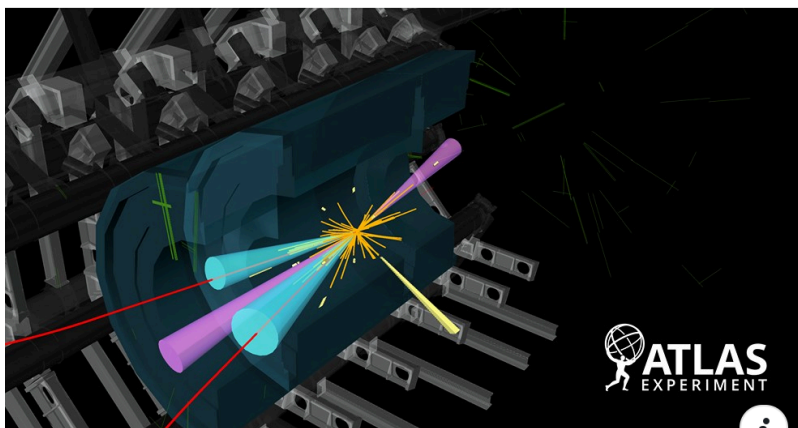
POPULAR CONTENT ON FACEBOOK

- ▶ The most popular posts (according to the number of likes) are about **physics results** and **detector news**

ATLAS Experiment at CERN 1 décembre 2020 ·

More than half of the Higgs bosons produced at CERN's LHC decay to a pair of b-quarks. Despite that, measuring these decays was a major challenge that experimental physicists spent many years chasing! It was finally accomplished in the summer of 2018, when the ATLAS Collaboration reported the observation of Higgs bosons decaying to b-quark pairs ($H \rightarrow b\bar{b}$).

Since then, measurements with more data have provided greater precision and deeper probes of this important interaction. R...
Afficher la suite



ATLAS.CERN
Studying the Higgs boson in its most common – yet uncommonly challenging – decay channel

450

5 commentaires 26 partages

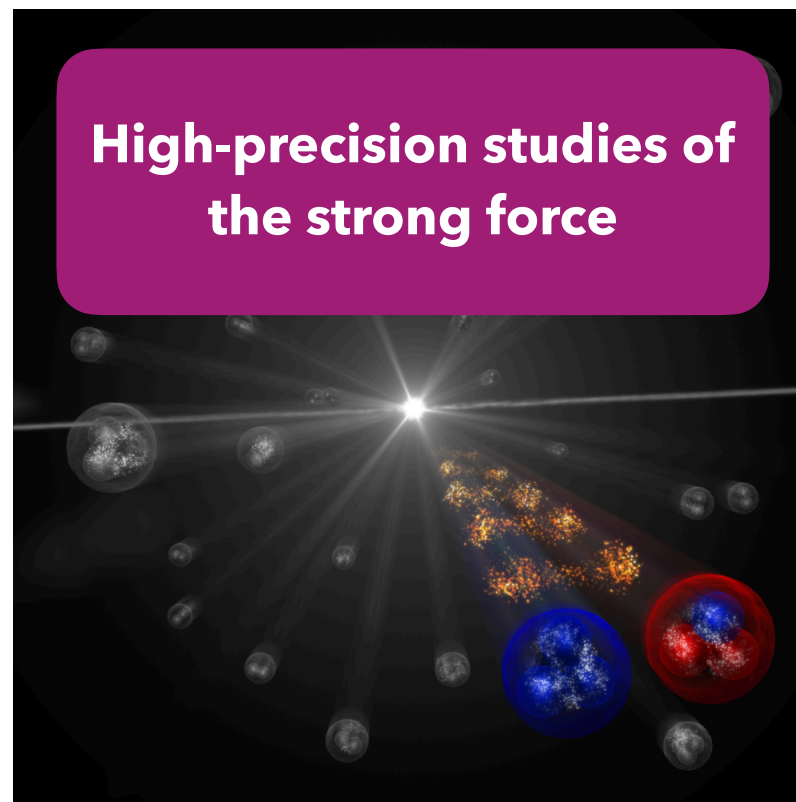
Studies of Higgs bosons decaying to b-quark pairs

ALICE experiment 9 décembre 2020 ·

ALICE collaboration at CERN opens avenue for high-precision studies of the strong force: shows how proton-proton collisions at the CERN LHC can reveal the strong interaction between composite particles called hadrons.

In a paper published today in Nature, the ALICE collaboration describes a technique that opens a door to high-precision studies at the Large Hadron Collider (LHC) of the dynamics of the strong force between hadrons.

Hadrons are composite particles made of two ... Afficher la suite



245

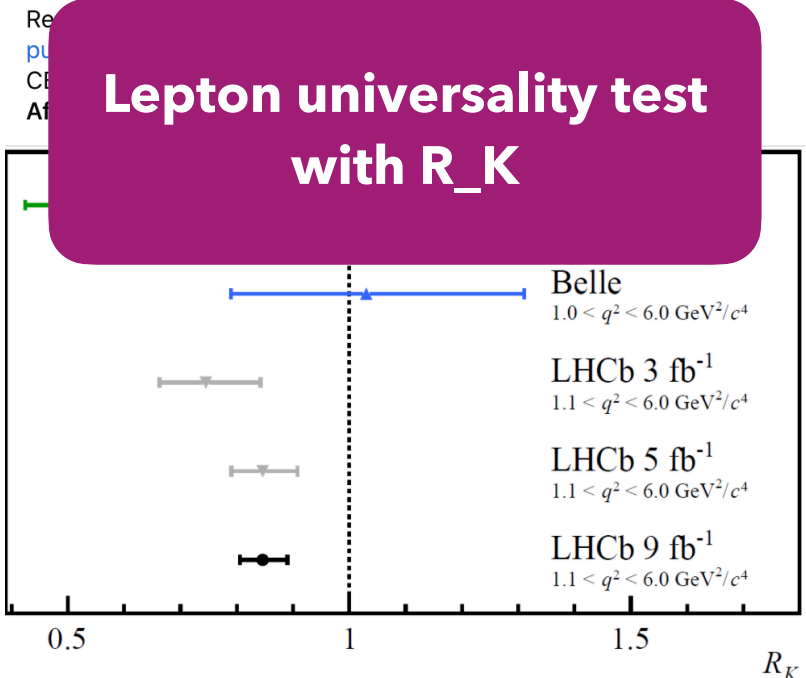
8 commentaires 59 partages

High-precision studies of the strong force



LHCb Experiment at CERN 23 mars ·

Today, the LHCb collaboration announces an update on the measurement of R_K . The result indicates an evidence for the breaking of lepton universality in beauty-quark decays, with a statistical significance of 3.1 standard deviations. This new result, if confirmed, would suggest hints of a violation of the Standard Model of particle physics.



347

9 commentaires 152 partages

CMS Experiment at CERN 3 juin 2020 ·

🎯 The delicate operation of bringing the CMS superconducting magnet from -269 degrees to room temperature has been successfully completed! 🙌 Good job! 🙌🙌🙌
But, wait a minute... why did we have to warm up the CMS magnet in the first place?



371

7 commentaires 39 partages

Warming up CMS magnet

► New LHCb results got a **wide coverage in the traditional national newspapers**

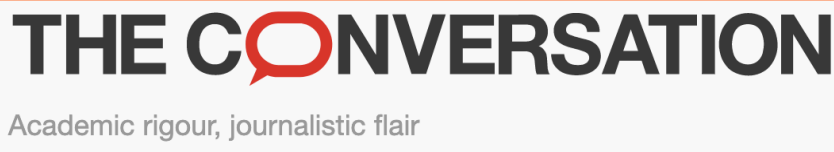


Lepton universality tests

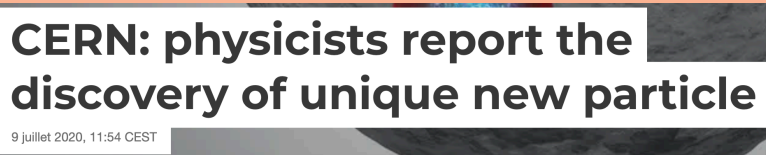
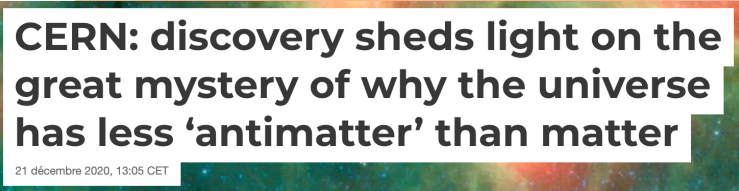
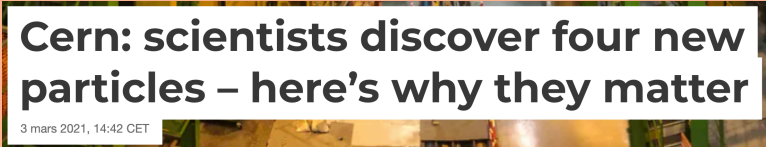
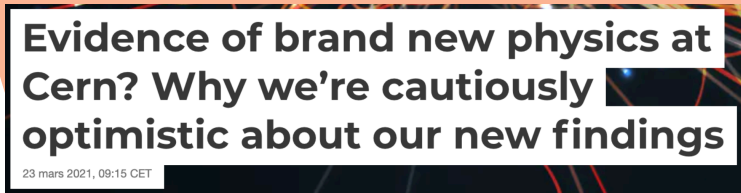
Tetraquarks



► But **more recent online media channels** were also used to spread the results to wider audiences, e.g.



- publishes news stories written by academics and researchers
- several editions for different regions ([Australia](#), [Africa](#), [UK](#)...)
- ~100k reads per LHCb story



- ▶ This year was **very challenging** for outreach but it also provided a fantastic opportunity to **reinforce the online presence** of the four LHC experiments
- ▶ Some activities were **successfully ported to a fully virtual mode** (Masterclasses, detector visits)
- ▶ Many **live events** were organised (heavily advertised on multiple social media) and allowed the public to **interact directly** with the researchers
- ▶ The development of new online material and activities will allow us to reach audiences that were difficult to involve due to geographical situation or social background: This is **a new opportunity to reach OUT!**



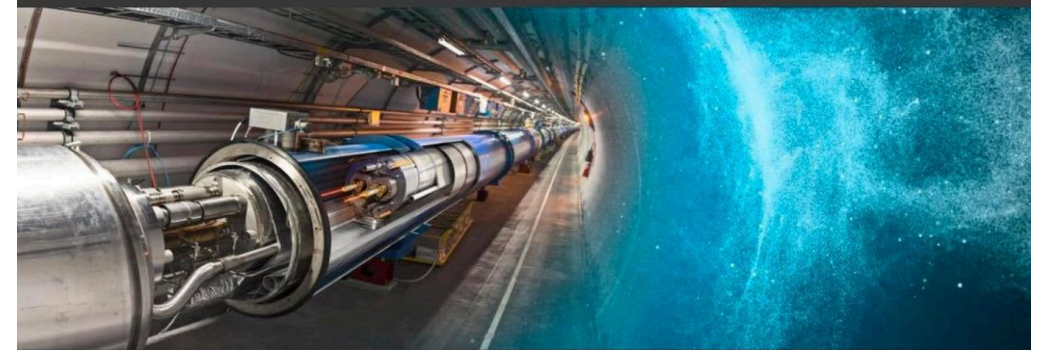
Back-up



- ▶ **Online panel event** with the 4 LHC experiments hosted by the Royal Institution in the UK on 24th September 2020
- ▶ **One speaker from each experiment with conversation facilitated by Royal Institution host**, broadcast live and with recording posted on youtube afterwards
- ▶ Few thousand viewers live + 49k views for the [Youtube video](#)

[Menu](#)[What's on →](#)

LIVESTREAM: 10 years at the LHC
7.00pm to 8.30pm BST, Thursday 24
September



A composite image of the Large Hadron Collider Credit: CERN



POPULAR CONTENT ON FACEBOOK



- ▶ **The most popular posts (according to the number of likes) are very much about physics results!**

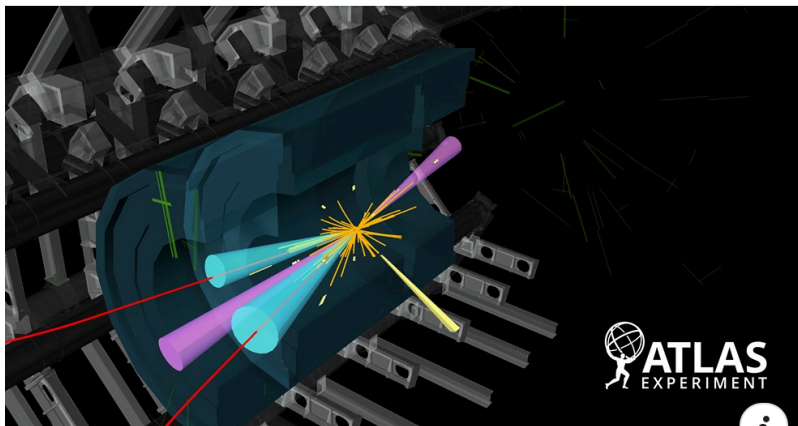


ATLAS Experiment at CERN ✓

1 décembre 2020 · 🌐

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[Afficher la suite](#)



ATLAS.CERN

Studying the Higgs boson in its most common – yet uncommonly challenging – decay channel

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Studies of Higgs bosons decaying to b-quark pairs



ALICE experiment ✓

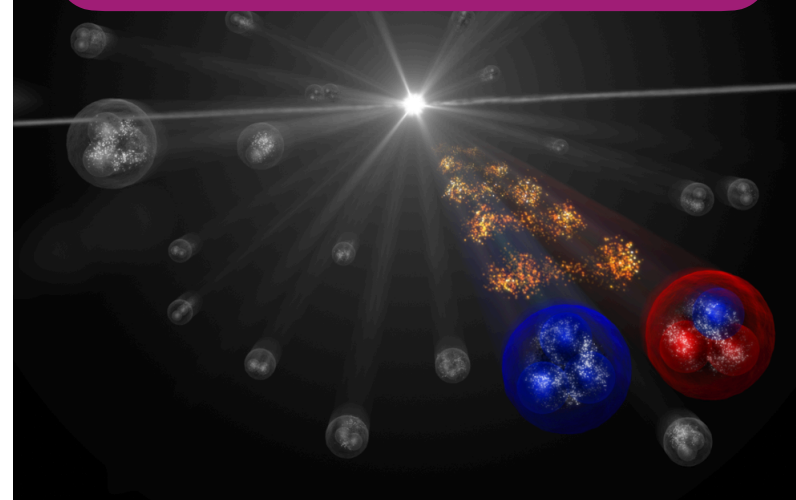
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Hadrons are composite particles made of two ... [Afficher la suite](#)

High-precision studies of the strong force



245

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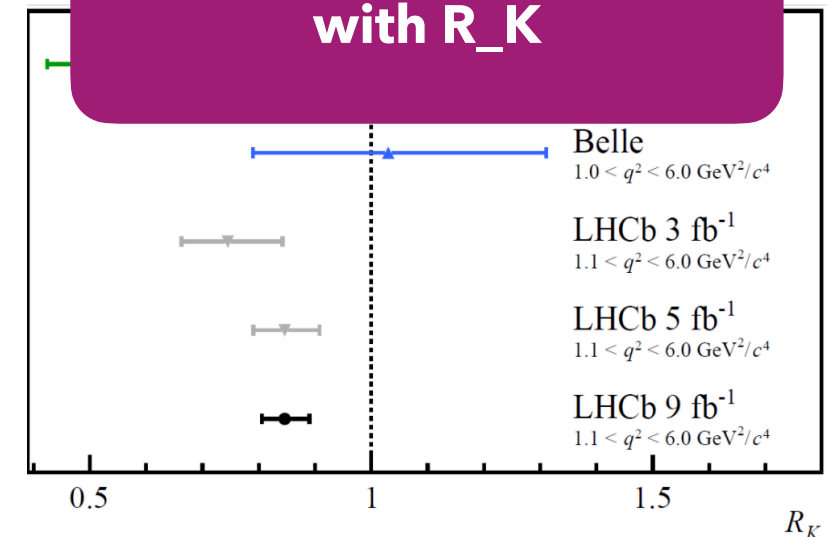


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Lepton universality test with R_K



347

9 commentaires 152 partages

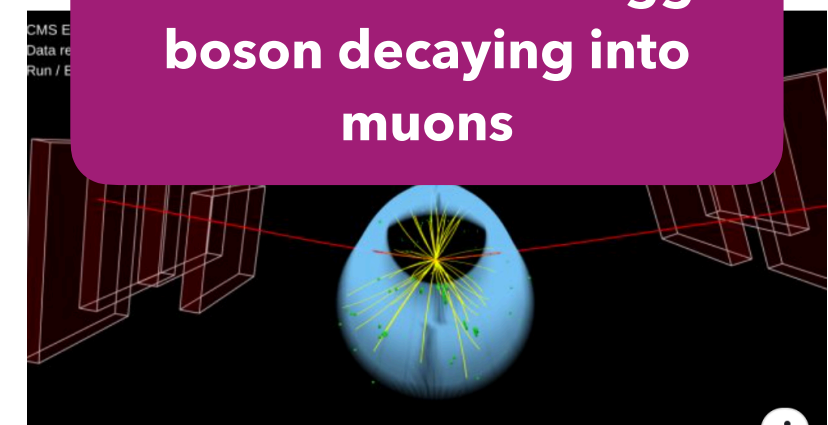


CMS Experiment at CERN ✓

3 août 2020 · 🌐

At the ICHEP conference in 2012 the discovery of the Higgs boson was announced. And for #ICHEP2020 CMS Collaboration presents the first evidence of the Higgs boson interacting with the muon!

Evidence for the Higgs boson decaying into muons



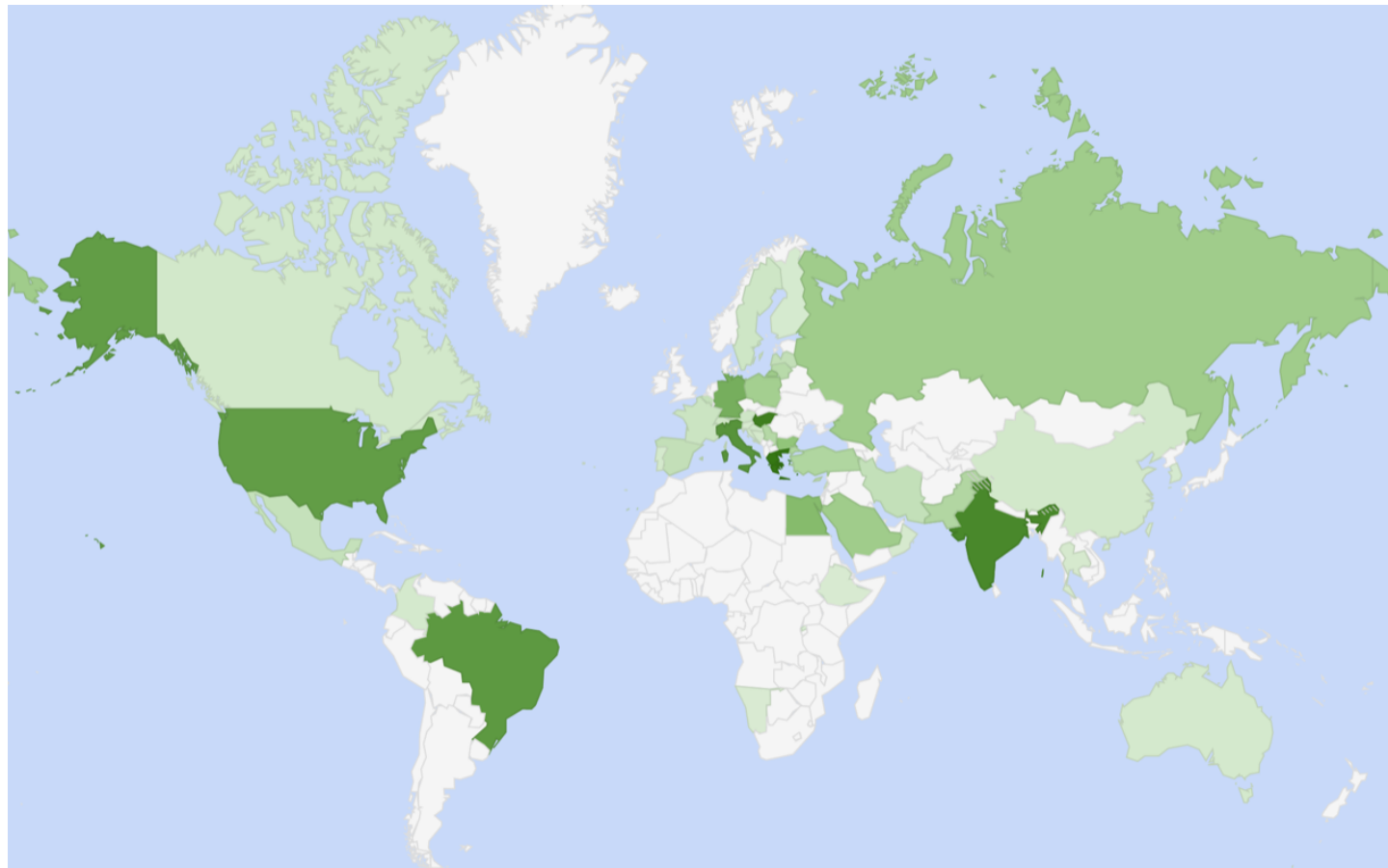
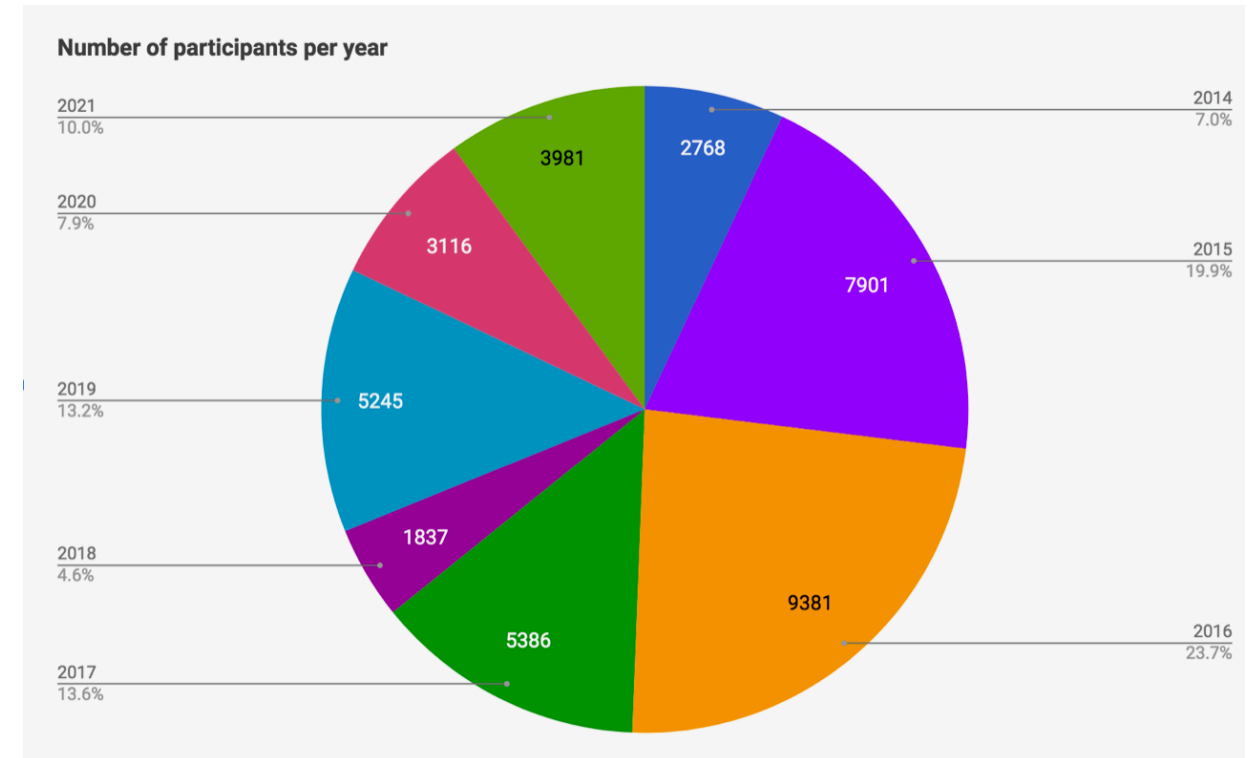
CMS.CERN

CMS sees evidence for the Higgs boson decaying into muons | CMS Experiment

197

5 commentaires 49 partages

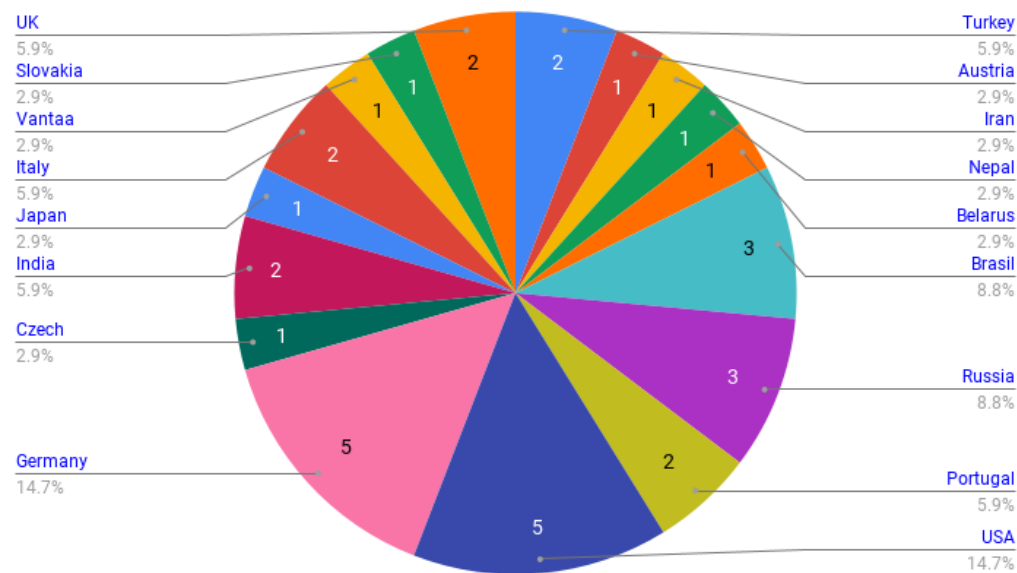
► **Statistics of number of participants per year in CMS virtual visits since 2014**



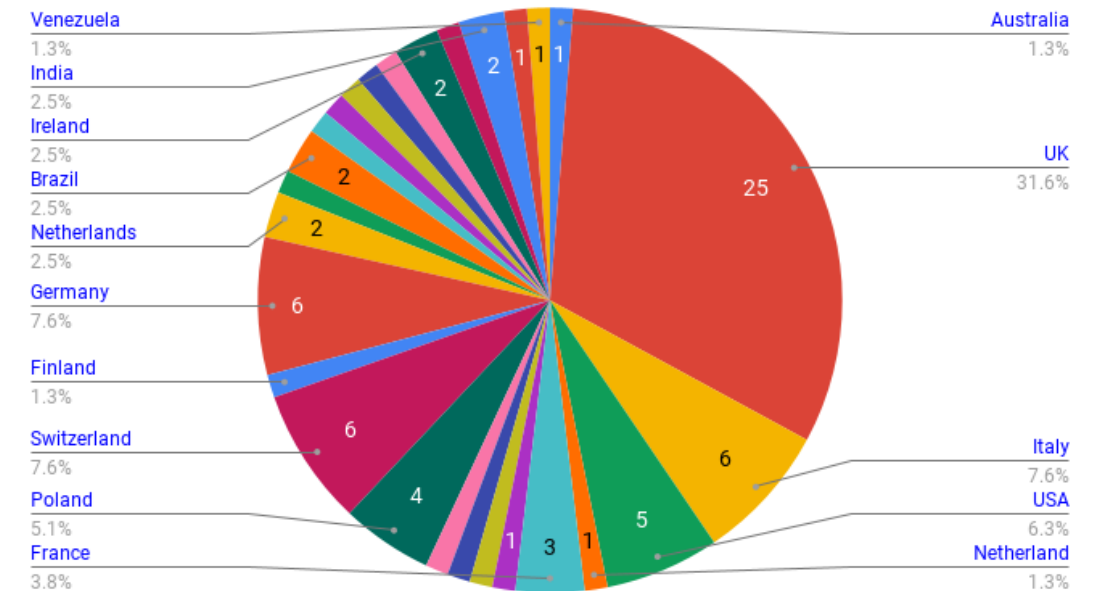
► **Countries from which groups connected to CMS virtual visits since 2014**

- **Pie charts of the audience countries and languages of the 34 ATLAS virtual visits organised in 2020 (left) and 66 visits in 2021 (right)**

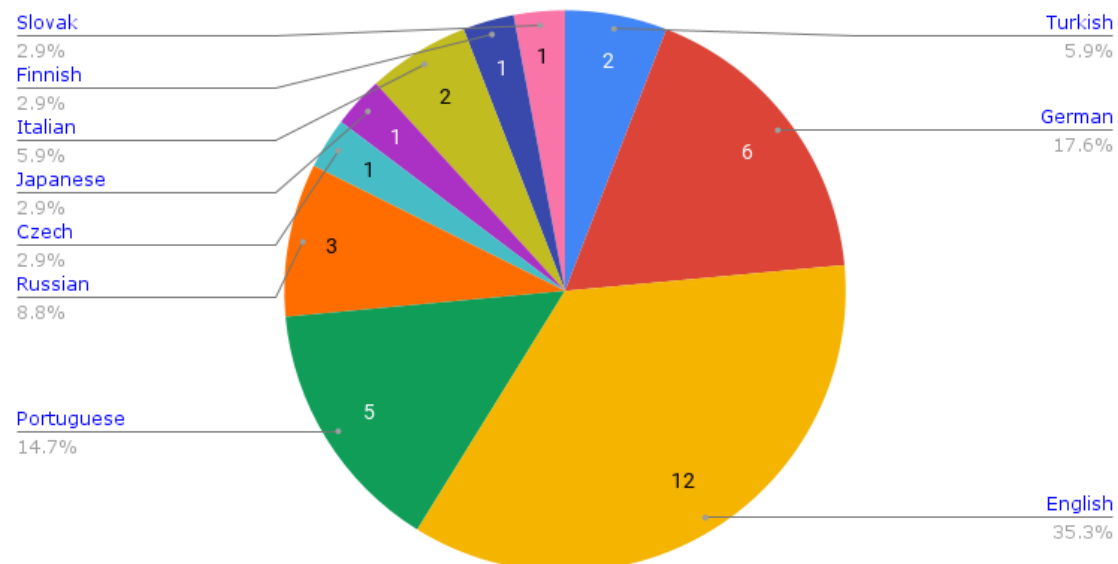
Distributions of audience countries



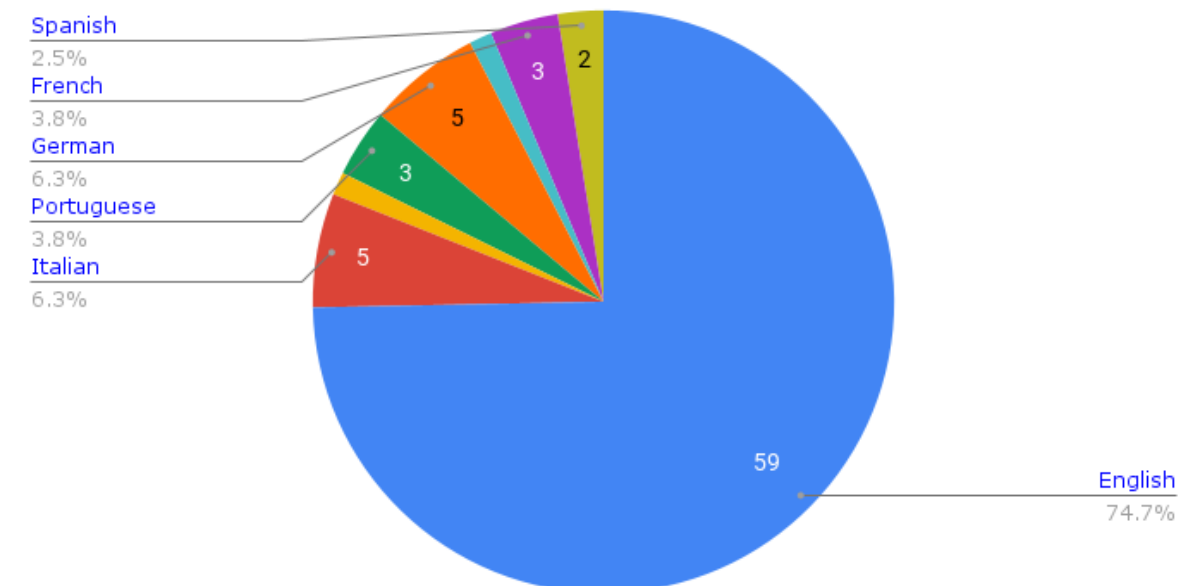
Distributions of audience countries



Language



Language



Youtube

LHCb Experiment: Active since 2019 (11k views 327 abonnés)
ATLAS Experiment: Active since 2007 (1.3M views, 7k abonnés)
CMS Experiment: Active since 2009 (483k views, 2.7k abonnés)
ALICE Experiment: Active since 2014 (92k views, 655 abonnés)

Twitter

LHCb Experiment: Active since 2009 (27.9k followers)
ATLAS Experiment: Active since 2009 (91.2k)
CMS Experiment: Active since 2009 (50k followers)
ALICE Experiment: Active since 2009 (33.4k followers)

Facebook

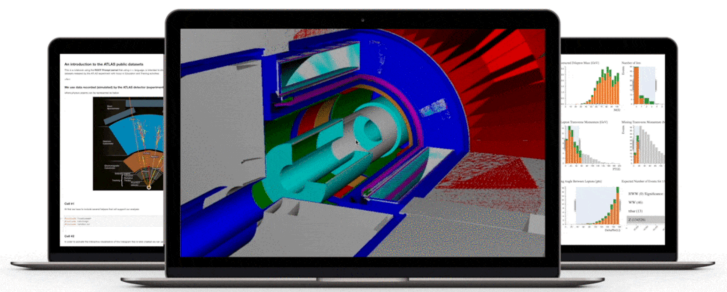
LHCb Experiment: 33 publications in the last year (17k followers)
ATLAS Experiment: 85 publications in the last year (35k followers)
CMS Experiment: 96 publications in the last year (22k followers)
ALICE Experiment: 65 publications in the last year (19k followers)

Instagram

LHCb Experiment: 12.4k followers
ATLAS Experiment: 29.1k followers
CMS Experiment: 16.2k followers
ALICE Experiment: 11.7k followers

- ▶ Several experiments have released open data in 2020 for educational purposes (ATLAS) or more scientific purposes (CMS)

- ▶ In February 2020, ATLAS released [data from pp collisions at 13TeV recorded in 2016](#) (with analysis tools and simulated datasets), targeted mainly at **physics undergraduate and masters students**

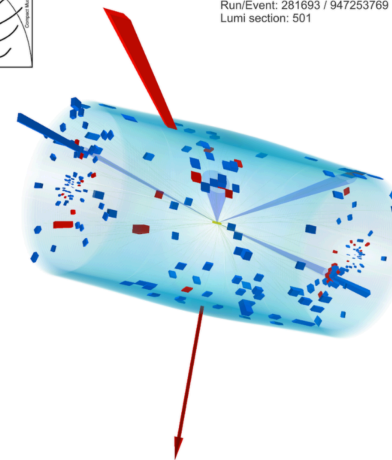


- ▶ [Online tutorials](#) are also available

- ▶ With the releases of this year, CMS has made public:
 - all the **pp collision data** recorded in 2010, 2011, and half of the amount collected in 2012
 - a first batch of data from **heavy-ion collisions**



CMS Experiment at LHC, CERN
Data recorded: Mon Sep 28 13:31 2016 PDT
Run/Event: 281693 / 947253769
Lumi section: 501



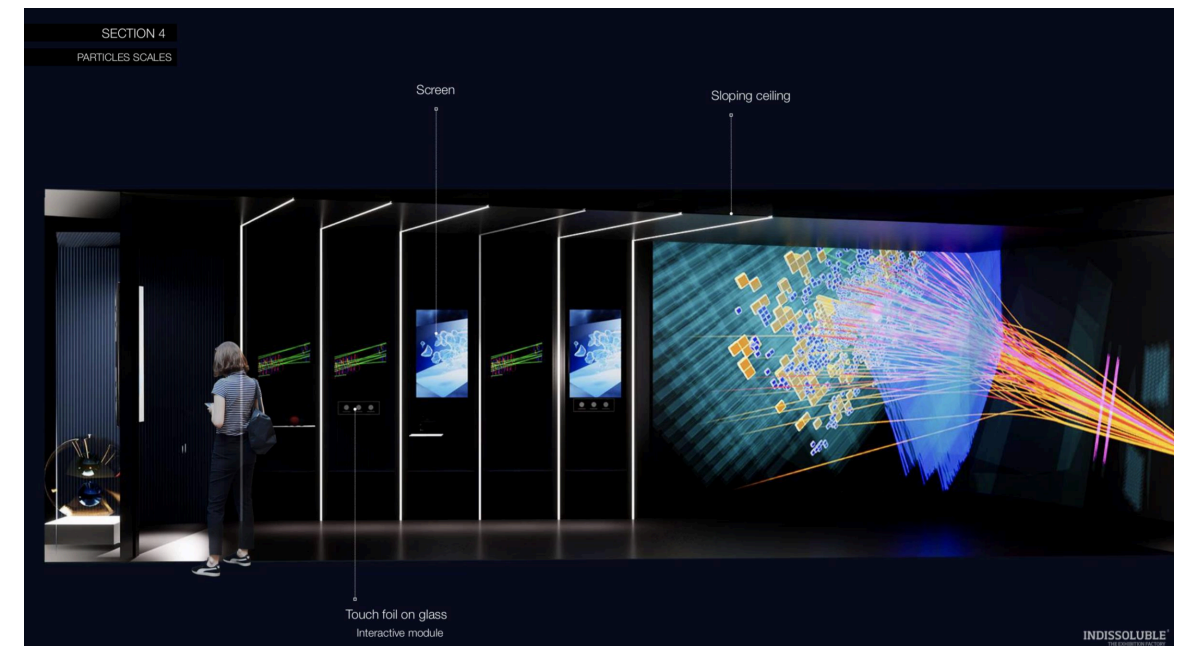
**CMS OPEN
DATA
WORKSHOP
2021**

CERN (Virtual)

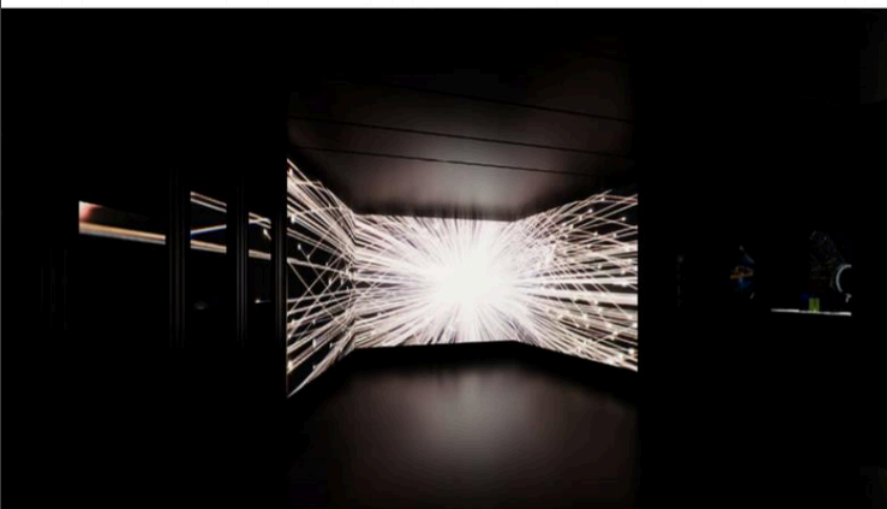
July 19 – 22

- ▶ CMS also has open data schools ([first edition in 2020, second in 2021](#)) **for non-CMS members!** This way the community (mainly **independent researchers**) can benefit from this data

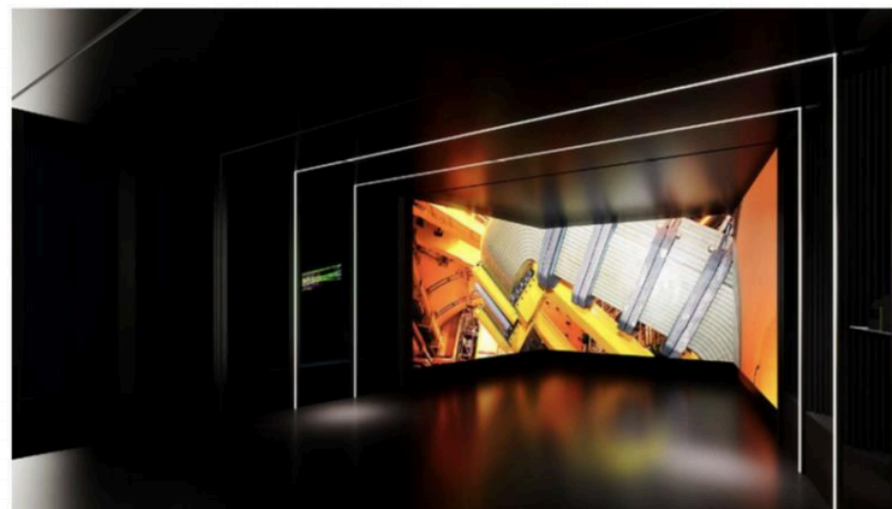
- ▶ In 2020, **wholesale redevelopment of the LHCb exhibition**, aimed at enriching the experience of visitors coming onsite for a guided visit
- ▶ Chosen design is from the firm **INDISSOLUBLE** (previously worked at CERN on the Microcosm and ALICE exhibition)



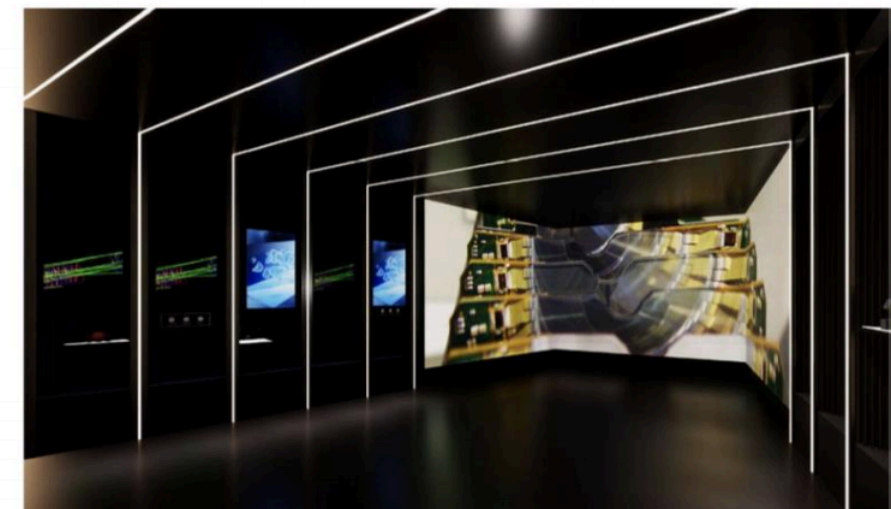
- ▶ Immersive and interactive experience using a **multimedia show**



1. STANDBY



2. IMMERSION



3. INTERACTION

Credits: [INDISSOLUBLE](#)