



Universidade do Minho  
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# Getting the public closer to the experimental facilities How Virtual Reality helps HEP experiments engage public interest

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ICHEP 2020 Conference - 28<sup>th</sup> of July to 6<sup>th</sup> of August of 2020

# High Energy Physics meets Virtual Reality

Science communication is a crucial mission for the whole field of physics!

At CERN, a dedicated group of people manage the complex visits calendar to enable thousands of members of the public every year to visit exhibitions, older accelerators and the famous detectors of the LHC.

The experimental area of many HEP detectors is difficult to access for many visitors for different reasons affecting the public engagement.



From a visitor during the CERN Open Days 2019:  
*"Visiting CERN is something I've wanted to experience for at least 20 years. To get to see things like the ATLAS muon spectrometer and calorimeter down in the cavern was so exciting (to that extent that my hands were a bit shaky)."*



NO  
UNDER **16**



# High Energy Physics meets Virtual Reality

## How can we improve?

- Virtual reality allows the public to explore experimental areas in an immersive and autonomous way;
- Additionally, being able to get closer to the detector or even to inaccessible parts of the inner-most sub-detectors, people can get a feeling of the size and the complexity of the experiment itself.



# High Energy Physics meets Virtual Reality

## What do we do?

- We bring the experiment to the visitor in different outreach and social events making use of the latest technologies in Virtual Reality (VR), Augmented Reality (AR), and 360 degree visualization;
- The public can travel from the control room to the experimental cavern having a complete immersive experience where all infrastructures and sub-detectors of the ATLAS detector can be seen;
- Interaction points are strategically placed enabling a 360 degree photograph of the surroundings where a comparison between the real world and the virtual representation can be performed.

# High Energy Physics meets Virtual Reality

## How do we do it?

- **ATLASrift**: a virtual reality software developed on top of the “Unreal Engine” framework (by Epic Games). ATLASrift can be used with all major VR headsets, but it has been customized for the “Oculus Rift”;
- The application has three “virtual spaces” for visitors to explore:
  - **Experimental cavern**, with complete representation of all the ATLAS sub-detectors, accesses and catwalks;
  - **The ATLAS Control Room and the CERN Globe**, where the most enthusiastic visitors can learn details of the experiment such as the data taking, the physics results as well as the history of CERN and the ATLAS Collaboration through virtual posters, videos and live websites visualization.

(VR application)



UNREAL  
ENGINE



oculus

(game engine / VR  
framework)

(VR headset  
drivers)

# High Energy Physics meets Virtual Reality

## What about the hardware?

- **A Laptop/PC** equipped with a **good graphics card**: standard PC/laptops are not sufficient, with them 3D graphics would not be smooth enough and people will get motion sickness. Official specs and recommendations can be found [here](#);
- **A VR headset**: maximum immersion effect can be achieved with the [Oculus Rift](#), but ATLASrift can also be run with other VR sets, like the [HTC vive](#);
- In the absence of the VR headset, ATLASrift can be used as a standard desktop application (like a videogame) where the mouse mimics the controller: check all the information [here](#)! Completing the set up with a screen in addition to the headset allows more people to be reached at public events.



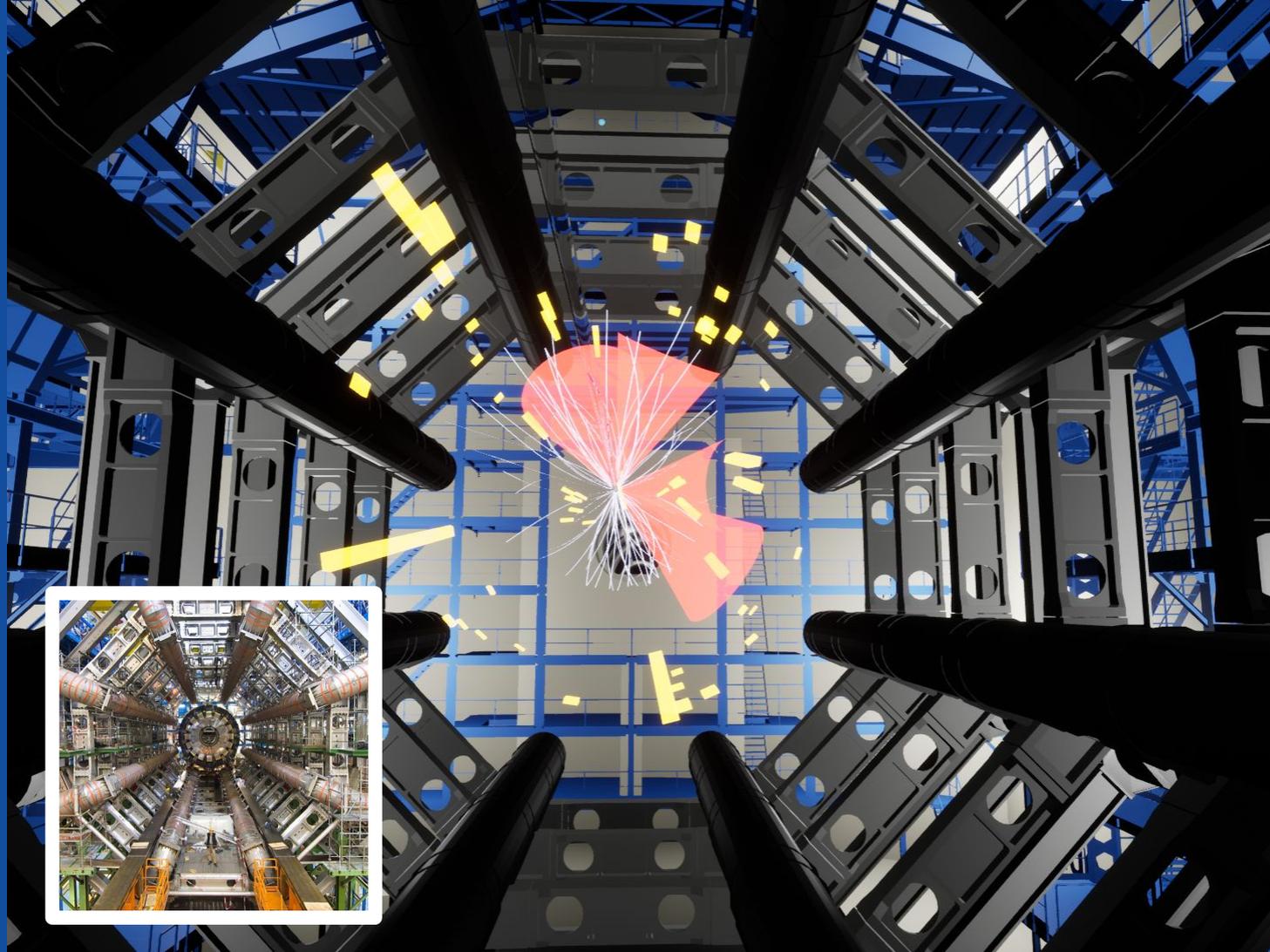
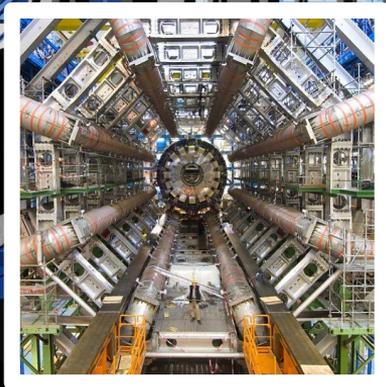
Let's start  
our journey  
with the first  
"taste" of  
the ATLAS  
cavern!

**A guided tour to  
the detector is  
also available in  
different  
languages.**

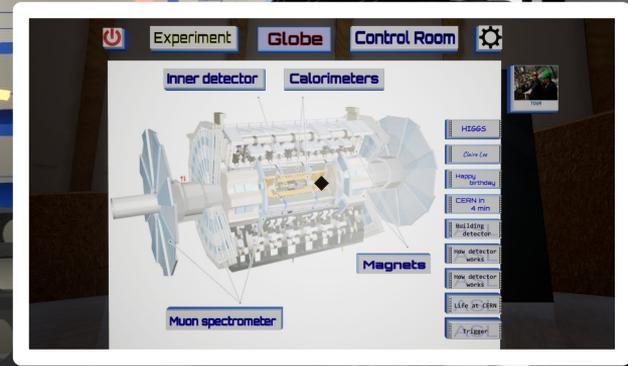


We can also see different event displays!

To compare with this old & famous photo!



There is a possibility to "remove" sub-detectors to help the visualization through this menu:



The ATLAS control room is also represented and data taking and analysis are explained here.



And next...

The virtual  
Globe gives  
us an  
exhibition  
with several  
posters,  
videos and  
miniatures of  
detectors to  
interact with.



History  
of  
ATLAS

1984-1992  
BIRTH OF THE LHC PROJECT

Oct 1, 1992  
ATLAS COLLABORATION PUBLISHES  
RESULTS ON BIRTH

July 1, 1997  
FEDERAL APPROVAL OF ATLAS EXPERIMENT

1998  
EXPLANATION OF THE ATLAS EXPERIMENT  
CAVERN REQUIRE

Nov 20, 20  
WORLD'S LARGEST SUPERCONDUCTING  
MAGNET BUILT

Aug 14, 2017

**FIRST DIRECT-EVIDENCE OF LIGHT-BY-LIGHT SCATTERING AT HIGH ENERGY ATLAS EXPERIMENT**

ATLAS  
ATLAS COLLABORATION

ATLAS publishes the first direct evidence of high energy light-by-light scattering, a very rare process in which two photons (particles of light) interact and change direction. The result, published in Nature Physics, confirms one of the oldest predictions of quantum electrodynamics.

A diagram illustrating light-by-light scattering at high energy. Two incoming photons (represented by blue arrows) interact and produce two outgoing photons (represented by yellow arrows). The diagram is set against a background of the ATLAS detector structure.

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- Oculus Go (a standalone version of the Oculus Rift) is also used to admire the ATLAS detector through 360 degree visualizations (a detailed guided tour also available through this [360 degree video](#));
- These panoramas were obtained by taking 360 degree photographs at strategic points of the cavern where the general public is not allowed to visit;
- Being a standalone device, it is very helpful during crowded events: while in the queue, the public can have an idea of what it will experience in the next minutes.



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Since the first version of the software, the participation of the ATLASrift in several events and the feedback received allowed a continuous improvement of the software as can be seen for this selection of events:

- Meeting of the Division of Particles & Fields 2015 in Michigan, United States of America;
- USA Science and Engineering Festival 2016 in Washington DC, United States of America;
- Fete de la Science 2016 in Geneva, Switzerland;
- ATLAS Christmas party 2017 at CERN;
- CHEP 2018 Conference in Sofia, Bulgaria;
- Relay race 2019 at CERN;
- LMU 2019 in Munich, Germany;
- Hardronic 2019 at CERN;
- European night of the researchers 2019 in Braga, Portugal.

Besides that, sharing experiences with the other HEP experiments developing Virtual Reality applications was very fruitful.

# High Energy Physics meets Virtual Reality



## Participation & Feedback:

- The interest from all ages is very noticeable being always one of the most crowded stands;
- Public usually has some scientific background and general interest in science;
- Reasonable participation and infinite curiosity from children, especially at events where more families are around;
- Occasions where **even the ATLAS members** can have a **real size notion of their own detector for the first time**;
- The audience particularly enjoys the interaction with the detectors and the possibility of freely exploring the experimental cavern as well as the other infrastructures and galleries.

# High Energy Physics meets Virtual Reality

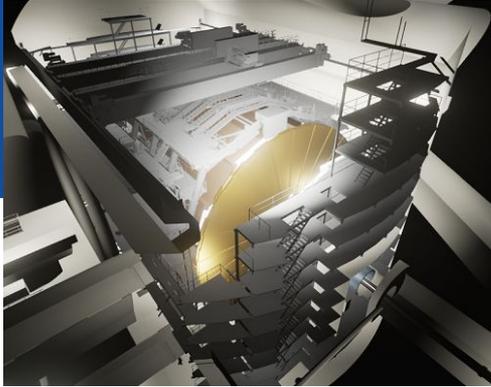
## Future improvements & COVID situation:

- The experience can be improved by the addition of sounds during the virtual visit:
  - > The ventilation, the racks, the pumps individual sounds and the people working on the experimental cavern are a very strong part of the experience of the underground visitors and it is one of the planned upgrades to the experimental cavern “virtual space” ;
- The current pandemic situation has posed many constraints on large public events and also on the use of the headsets by many people. However there is an upside to these restrictions : a growing community of citizens have their own equipment and can enjoy the ATLASrift experience from their homes.
  - > Additional features can be added to facilitate the self-learning by the general public;
  - > Online public events where this community can be guided through the application by a physicist is an interesting possibility for future events.

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## Concluding:

- Virtual reality proves to be a great opportunity to engage public both for educational purposes and for outreach and media events;
- Difficulties in visiting the experimental areas and current constraints on travelling can give a boost to these new outreach activities;
- Past feedback from several events demonstrate the constant interest from all the participants - only possible through a real representation of the ATLAS detector;
- Further improvements to enrich the experience in progress as well as the participation at future outreach and social events!



# Thanks!

## Any questions?

You can find us through

<https://atlasrift.web.cern.ch/>

or join our "Virtual Worlds" mailing list:

[atlas-outreach-virtual-worlds@cern.ch](mailto:atlas-outreach-virtual-worlds@cern.ch)