

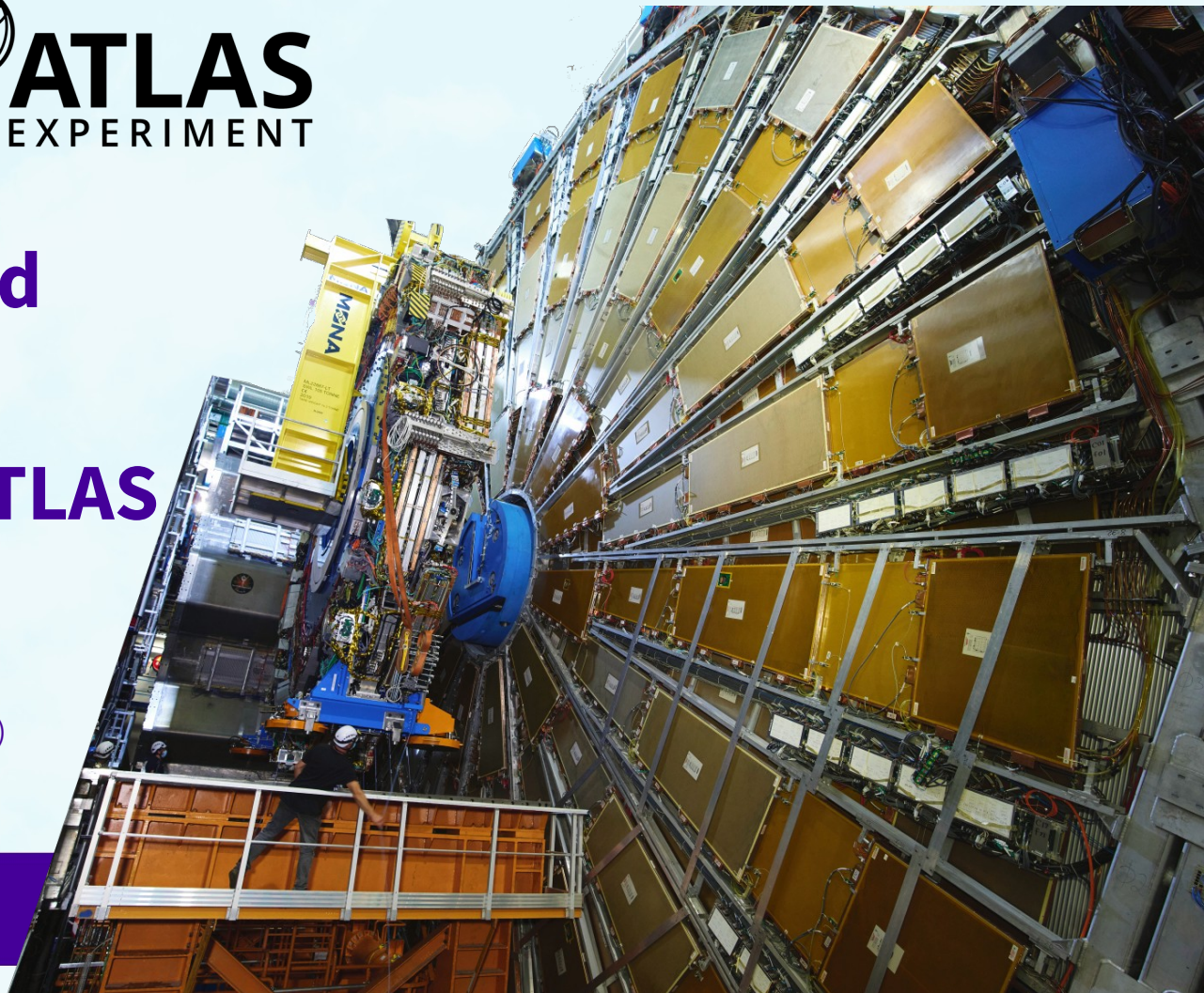
Virtual tours and Videogames to showcase the ATLAS experiment

Dr Kristin Lohwasser (University of Sheffield)

Leah Dungay (NVM)

On behalf of the ATLAS Collaboration

ICHEP July 2024



A worldwide collaboration...

... comes with challenges to include the local population financing our research:

University of Sydney

16 764 km (min 23h 50 min)

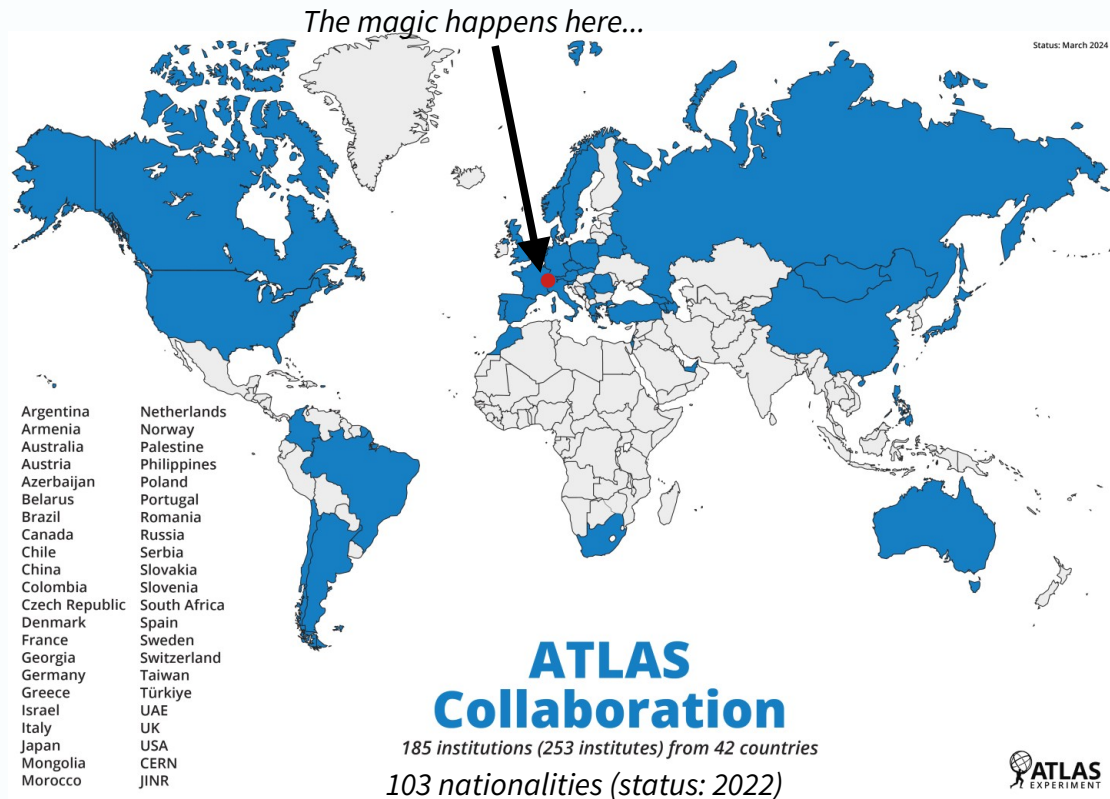
Universidad de la Serena, Coquimbo, Chile

11 482 km (over 18 h)

University of Sheffield

1 205 km (1 h 45 min)

Visits are out of question for most (even for Sheffield restricted to private institutions)



One remedy: Virtual Visits

2023:

- 90 virtual visits in total
- 47 visits to the ATLAS visitor centre
- 40 underground
- 2 streamed on YouTube
- 1 general public

*Between 10–1000
participants per visit.*



2024:

- 84 so far

Facilitated at CERN by CERN-based staff

Video calls with ATLAS guide at
CERN: reaching out to participants
around the world



<https://atlas.cern/Discover/Visit/Virtual-Visit>

Fully remote ATLAS tours

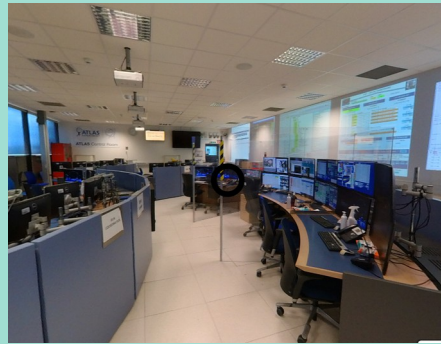
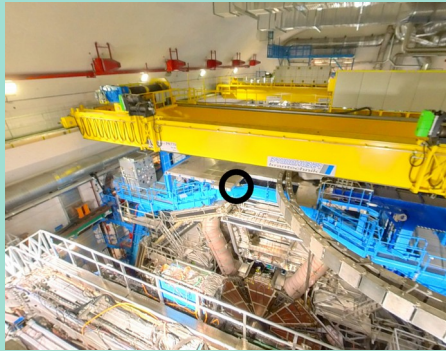
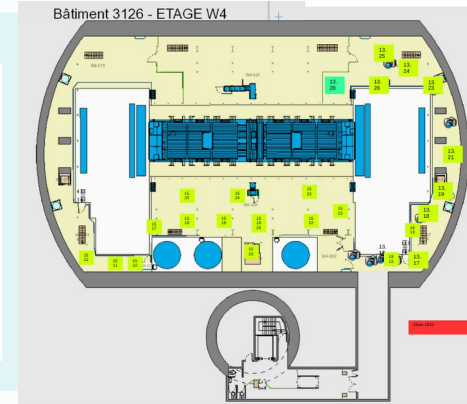
Outcome of a **3-year STFC public engagement award at the University of Sheffield** - with the aim to enable researchers abroad to guide a visit to CERN

Three major milestones / Objectives:

- 1) Development of interactive ATLAS VR model
- 2) Deployment of model within exhibition in the National Videogame Museum in Sheffield
- 3) Workshop on video game development with ATLAS VR as an inspiration

The tour

- Used InstaX3 (360 degree camera, borrowed from University media services)
- Took > 200 pictures from different places within the cavern (available within collaboration)
- Slightly worse quality (compared to e.g. LHC panoramas)



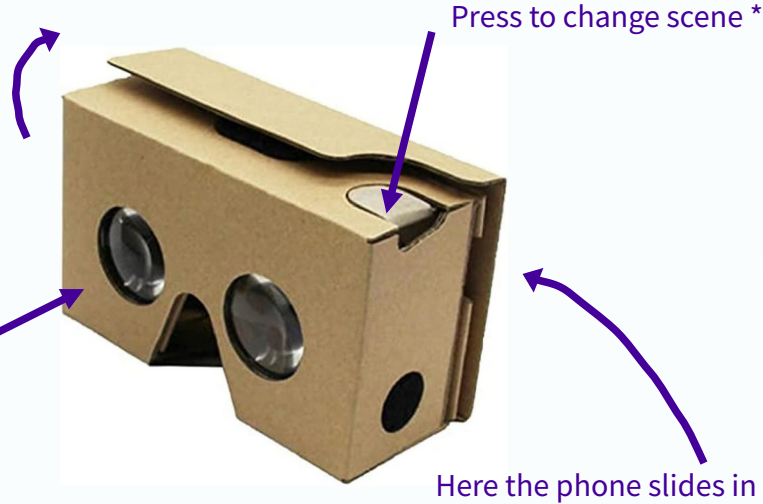
Compiled into tours of static scene using different means:

- Webpage (2 tour variations)
- Google cardboard (4 tour variations)
- Mozilla Hubs (discontinued)

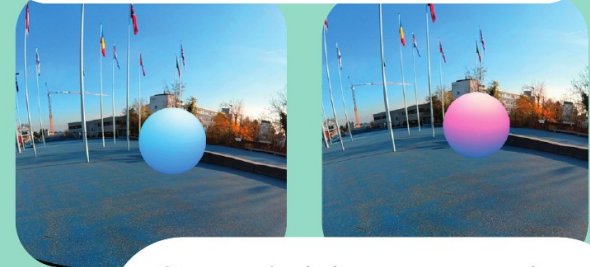
Google cardboard...

Move your head around →
look up and down, you can
look all around in the scene

Look
through
here



To get started put the headset on and
look around to discover the space.



Geometrical shapes are portals to
the next scene – once you look
straight at them, they change colour.
Press the button when it turns pink
to be transported.



Cardboard: 5 – 10 GBP

(plastic ones also available, but more expensive)

Phone 49.00 – 65 GBP

(Motorola Moto G5 16GB 2GB Unlocked XT1675 SINGLE SIM,
Can be cheap specs, but **needs gyroscope!**)

Implemented using Unity game engine

Standalone .apk application for Android → phone can run without mobile/internet.
Works ~4 hours without charging

... and webpage

ATLAS experiment *(included in short version)*

Control Room, Visitor centre
Cavern entry, Lift, toilets
Cavern: *Detector from side, behind and top*
Beam pipe,
Muon system *from the side*, cabling
Computing room



CERN reception/tram stop

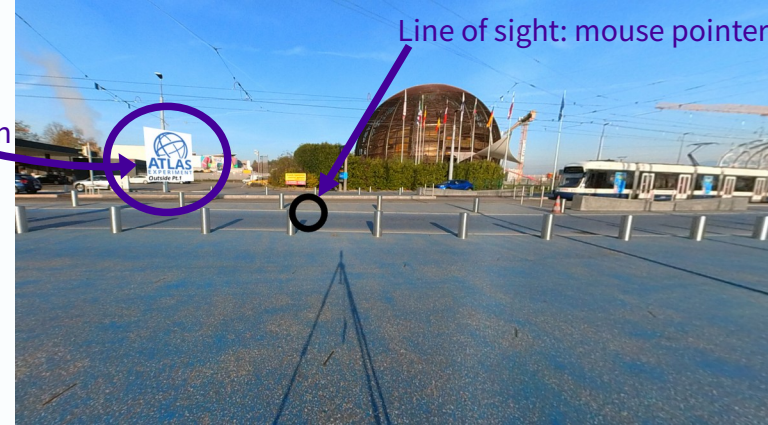
CERN site

Office B1
Canteen / R1
Outside R1, outside B40
B40 downstairs
B40 office

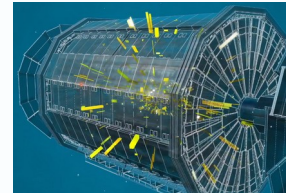


24 different scenes – works on oculus rift

Link to change to next scene (activated when in line of sight)



Line of sight: mouse pointer



Link to further information



<https://lhc-panoramas.web.cern.ch/lhc-panoramas/>
ATLAS Collaboration DOI: [10.22323/1.390.0954](https://doi.org/10.22323/1.390.0954)

Use cases: Exhibitions and Talks

Lightweight and cheap VR head set works well for exhibitions:

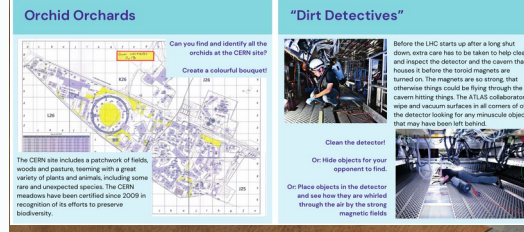
- STFC Daresbury lab open days
- Museum exhibition (+ATLAScraft, exhibition on physics in videogames and project on rigid body avatars)
- Stand up for STEM event



Webpage works for talks

- School visits, Pint of Science
-

→ Over 3000 people reached



Invent a “CERN video game” poster
Brochure with stops on short tour

Brochure for short tour

A Virtual Tour through the ATLAS Detector at CERN

Explore one of the World's Largest Scientific Instruments

1 The ATLAS Detector
The ATLAS detector is one of the four major experiments of the Large Hadron Collider (LHC) at CERN. ATLAS is like a gigantic microscope with a camera that can take 40 million pictures per second, each of 100 million pixels. It is a general-purpose detector designed to be sensitive to the widest possible range of physics at the LHC. The detector built as a cylinder, 46m long, 25m in diameter. Scavenging runs along the walls of the cavern around the detector on 13 levels. We start on the first floor with our tour.

2 Head to the Third Floor
On the 3rd floor, just two flights of stairs up and on the opposite side, we can see the detector bit better. It has been opened up and the crystal has been moved out an orange support structures. This very large crystal contains the eight superconducting coils of the First Gap. Tended for the ATLAS magnets. When excited to the nominal current, 20000 A (low inductance) in the superconducting coils. Also, the Main Wheel is visible in full glory. This large structure looks like a flower in full bloom with golden-coloured petals radiating outwards. It is designed to direct muons – particles that deposit as little energy that they are not stopped in the inner parts of the detector.

3 Up to the Top!
Finally we reach the top. Look up at the shaft, a huge hole used to lower parts of the detector down for assembly. A nerve-racking experience. It takes hours as the large parts are carefully moved millimetres by millimetres. The shaft is very narrow, and smashing a unique and irreplaceable part into the concrete wall would be fatal.

4 The LHC Beamline
Then we take a look at the LHC beamline (blue pipe at the end of the shaft). The beams in the LHC are made up of bunches of protons, spaced seven metres apart, with each one containing more than 100 billion protons. The silver pellets are again parts of the muon detector (how seen from the other side).

5 Cables!
Cables transport the information from the detector to the computers analysing the data. If hot and/or cold, these cables would stretch from Los Angeles to Boston, with a length of almost 3000km.

6 In the Rack Room
The two rack rooms house more than 200 racks. The area is accessible at any time, which is not the case for the experimental cavern due to the high level of radiation when the beams are on.

7 The Control Room
Back upstairs, there is the control room where the data taking is supervised. ATLAS comprises about 3000 sensors (including subdetectors) coming from 83 institutions around the world, representing 38 countries from all continents. Beyond ATLAS itself, the collaboration also includes a lot of engineers, technicians and administrative staff.

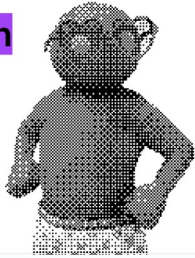
Dr. Kristin Lohwasser
University of Sheffield
Department of Physics and Astronomy
Hicks Building, 53 Trow

In collaboration with:
NIM National Instruments
University of Sheffield
ATLAS EXPERIMENT

Discover ATLAS on the web!

Workshops: ATLAS and Videogames

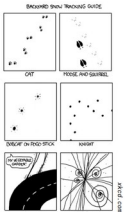
A tour through the ATLAS detector



Collisions & Decays

Once all particles of a collision have been measured and identified according to their unique "footprint", particle physicists can reconstruct, what happened in a collision by considering also combinations of particles that might stem from the decay of a heavier particle.

They can also convert the **count** of events of a certain type into a **probability** which is related to the strength of an interaction.



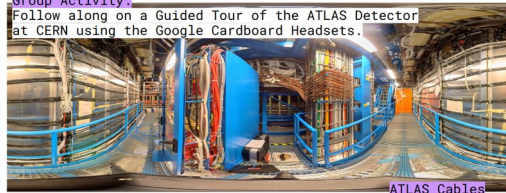
A Group Effort!

More than **3000 scientists** from all over the world work on the ATLAS experiment and contribute to the results in their own way.



Take a Tour of the ATLAS Detector

Group Activity:
Follow along on a Guided Tour of the ATLAS Detector at CERN using the Google Cardboard Headsets.



<https://www.hep.shef.ac.uk/dowasser/atlas-tour/smalltour.html>

Structured workshop developed

- Collaboration with Leah Dungay (NVM)
- Targeting Y12 (16-18 year olds)
- 1 - 1.30 hours

Combining ATLAS, VR tour and Videogames:

- Introduction to the ATLAS experiment
- Short tour through ATLAS
- Discussion of physics in videogames
- Hands-on design of videogame

Facilitated at National Videogame museum and University of Sheffield
Plan to develop version for younger audience

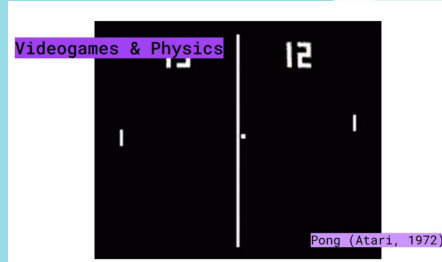
Physics in Videogames

Physical behaviour in videogames driven by "Physics engine"

Differential equations describing e.g. shoots in FIFA series.

→ Improvement in maths led to significantly more natural reactions of the ball

Equations calculated for rigid bodies



Genre

1. Racing
2. Sandbox
3. Puzzle
4. Multiplayer
5. Battle Royale
6. Platformer

Goal

1. Escape
2. Survive
3. Reach Destination
4. Remove all Enemies
5. Rescue or Capture
6. Highest Score

Feedback



Workshop tested with over 50 participants so far

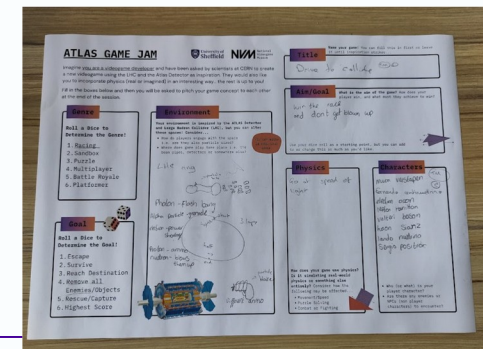
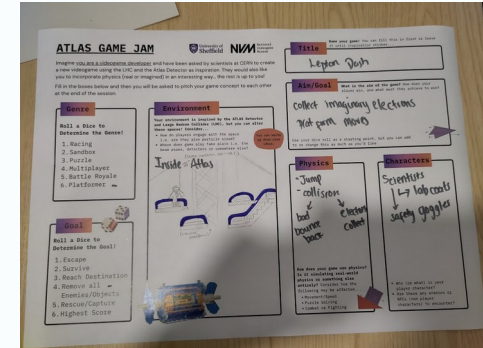
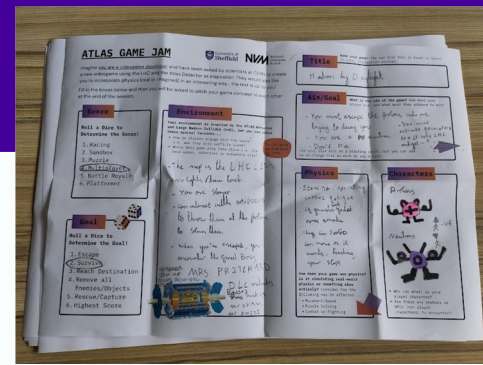
Feedback received from 25

Workshop rated as outstanding: 4,4 ★★★★★

Rated difficulty as 2.8 - right in between too hard (5) and too easy (1)

50% feel more likely to consider studying science for A Level or at university

50% feel they are more likely to consider a career in science



Conclusions

Created new outreach materials suited for remote promotion of ATLAS

- Cheap and portable VR viewer
- Virtual tour website
- Hands-on Workshop on ATLAS and videogames

Good feedback from tours and workshops

<https://www.hep.shef.ac.uk/lohwasser/atlas-tour/smalltour.html>

https://www.hep.shef.ac.uk/lohwasser/atlas-tour/fulltour/1_reception.html

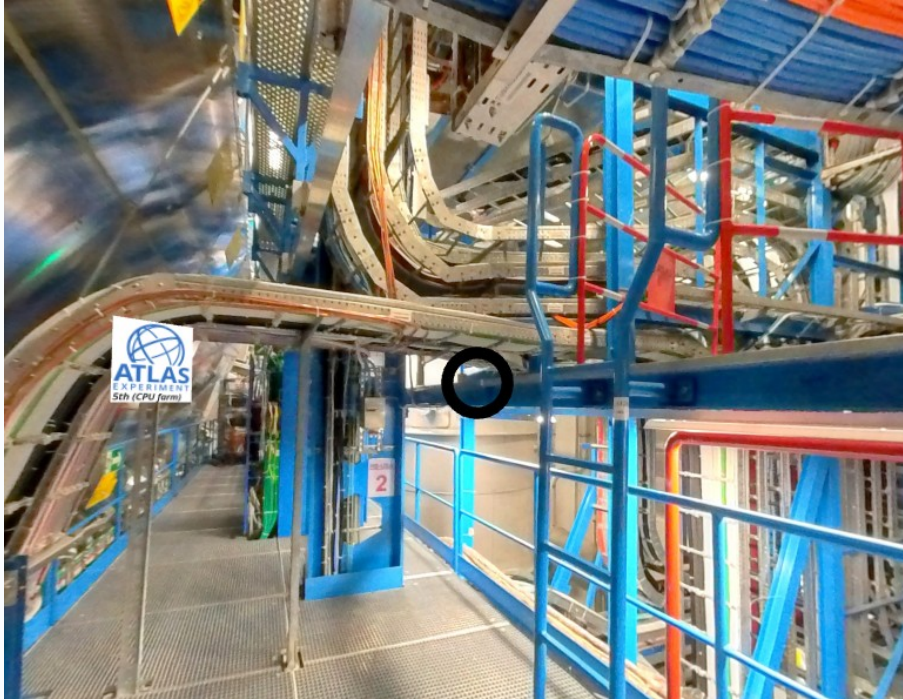
Feel free to contact for questions on the mobile phone app

Backup

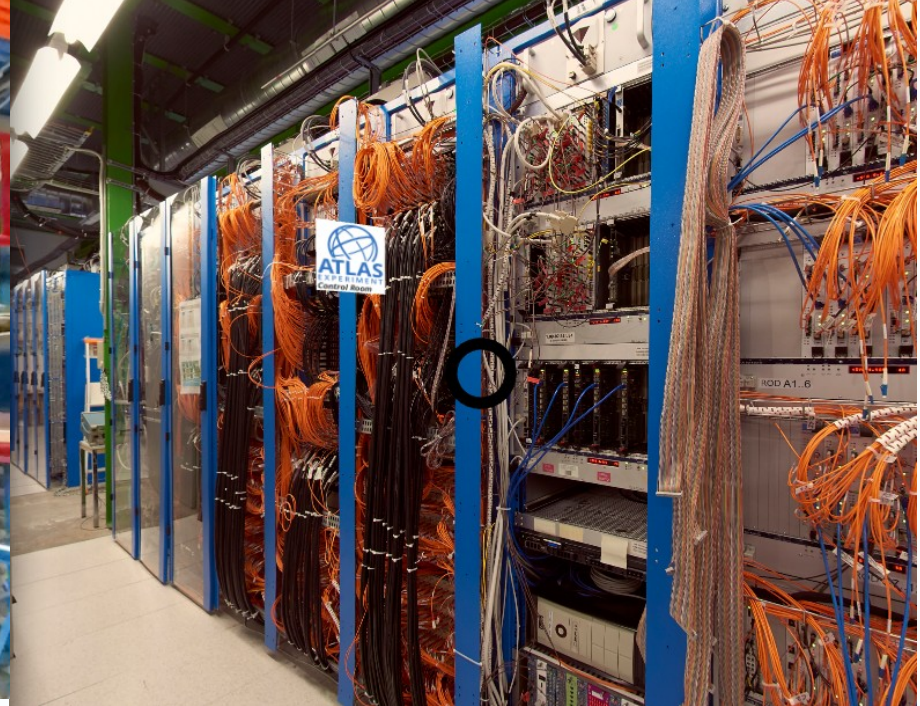
k.lohwasser@sheffield.ac.uk

Difference in resolution

Left: InstaX 360 camera



Right: CERN 2-stereo HD camera setup



Mozilla Hubs (goodbye...)

Discontinued service added possibility to interact via avatars and sound

You will be “teleported” into a scene at CERN, but clicking anywhere in the picture and holding the mouse button you can turn around, look up and down and all around. Exceptions are:

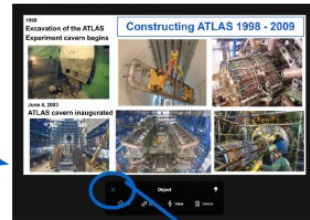
- 1) Portals
- 2) Media (Photo, Video)



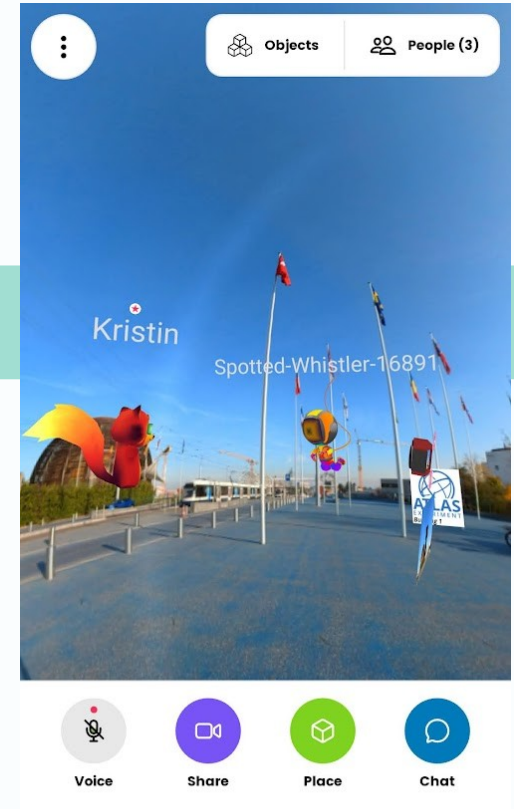
Let's keep muted unless you have a question (helps with performance), but feel free to ask a question anytime!!



- 1) Portals
Click on pink link to get to the next scene
CAREFUL: Not possible to get back - wait till the group goes



- 2) Media
Right click to make media full screen - then close using x



Large tour

Left: InstaX 3

ATLAS experiment

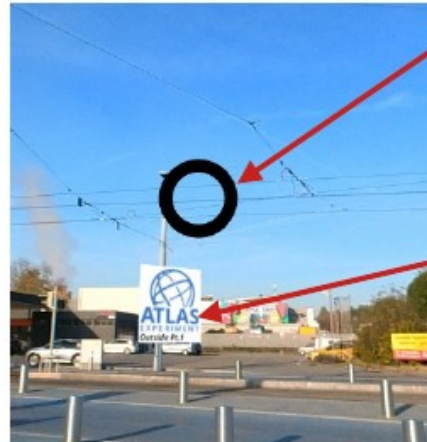
- 2_OutsideP1
- 3_ControlRoom
- 4_VisitorsCentre
- 5_EntryCavern
- 6_LiftUpstairs
- 7_LiftDownstairs
- 8_Toilet
- 9_W4FromLift
- 10_W4Opposite
- 11_W2_ECOpposite
- 12_W2BacksideDet
- 13_TopView
- 14_U0TourView
- 15_BeamPipe
- 16_MuonSystem
- 17_W2CableSide
- 18_USAComputer

1_Reception

CERN site

- 19_B1Office
- 20_R1
- 21_OutsideR1
- 22_OutsideB40
- 23_InsideB40
- 24_B40Office

setup

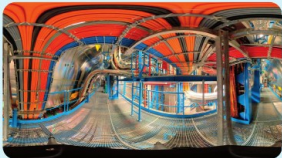


Line of sight → when hovering over a link will contract and “click”

Link to another scene

To go back: just use “back” arrow in browser

Brochure



7 The Control Room

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© Dr. Kristin Lohwasser
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In collaboration with:



A Virtual Tour through the ATLAS Detector at CERN



Explore one of the World's Largest Scientific Instruments



This virtual underground tour showcases the large ATLAS experiment.



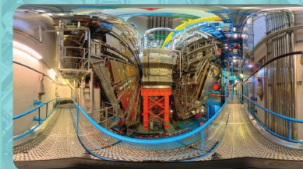
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2 Head to the Third Floor

On the 3rd floor, just two flights of stairs up and on the opposite side, we can see the detector a bit better. It has been opened and the cryostat has been moved out on orange support structures.

This very large cryostat contains the eight superconducting coils of the End Cap Toroid for the ATLAS magnets. When excited to the nominal current, 20,000 A flow (without resistance) in the superconducting coils.

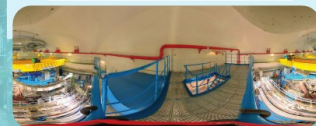
Also, the Muon Wheel is visible in full glory. This large structure looks like a flower in full bloom with golden-coloured petals radiating outwards. It is designed to detect muons – particles that deposit so little energy that they are not stopped in the inner parts of the detector.



Discover ATLAS on the web!

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4 The LHC Beam pipe

Then we take a look at the LHC beam pipe (blue pipe at the end of the alley). The beams in the LHC are made up of bunches of protons, spaced seven metres apart, with each one containing more than 100 billion protons. The silver plates are again parts of the muon detector (now seen from the other side)

