

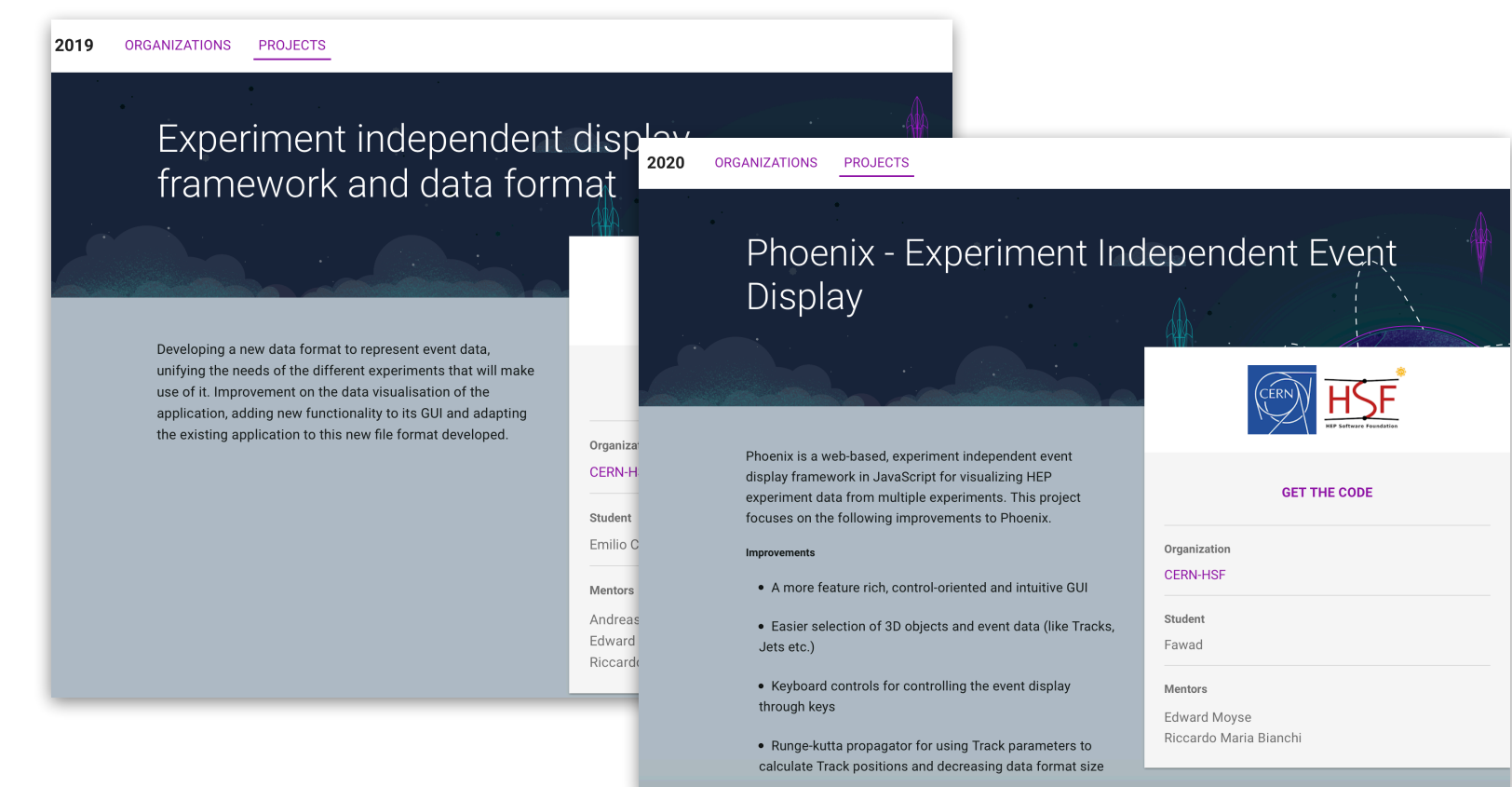
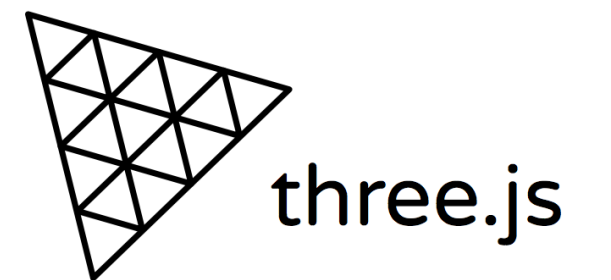
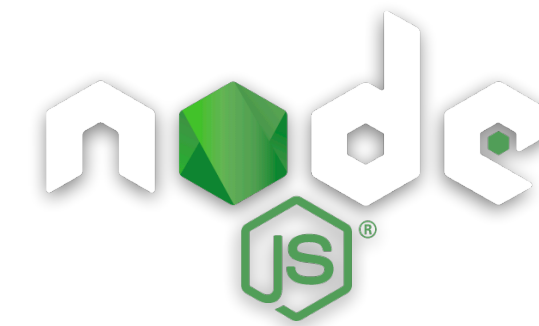


EDWARD MOYSE

PHOENIXATLAS

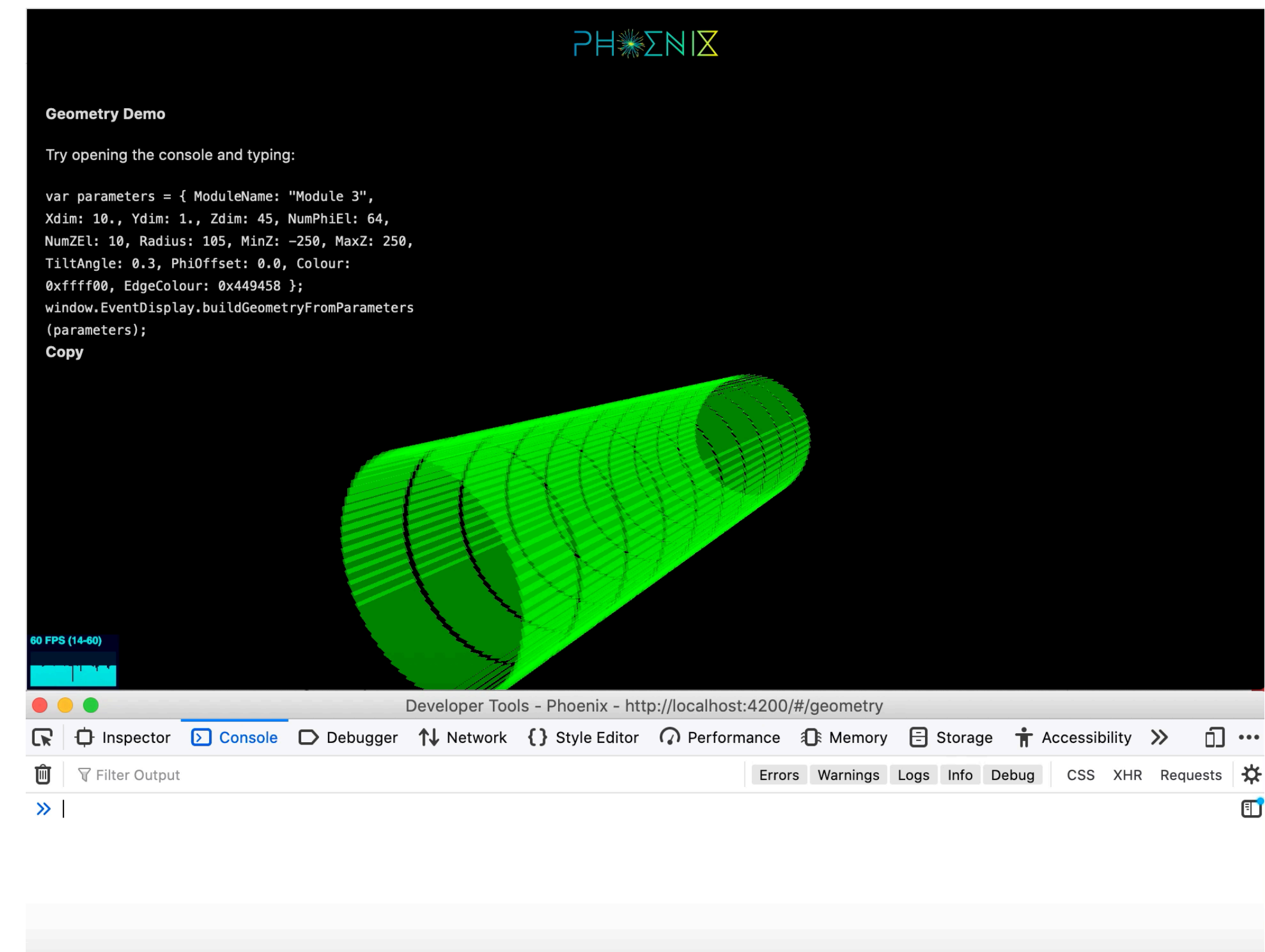
- ▶ In this talk:
 - ▶ I will first introduce the main Phoenix framework:
 - ▶ Some of its key features
 - ▶ Recent developments
 - ▶ Then, since I'm a member of ATLAS, introduce PhoenixATLAS, the ATLAS specific implementation
 - ▶ It is an example of how you can tailor Phoenix...
 - ▶ Will also give a short demo, including the new masterclass example

- ▶ Phoenix is an event display framework, created as a result of the HSF [visualisation](#) white paper :
 - ▶ Repository: <https://github.com/HSF/phoenix>
 - ▶ Demo: <http://hepsoftwarefoundation.org/phoenix/>
 - ▶ Runs entirely in the browser, so scalable and cheap to host
 - ▶ Uses [three.js](#) and [angular](#), nodeJS, NPM (+ other libraries)
 - ▶ (Also a [demo](#) using [reactjs](#))
 - ▶ Experiment agnostic and extensible by design
 - ▶ Has support for LHCb, ATLAS, FCC, CMS and TrackML **geometry** and **event data**
- ▶ Accepted for [Google Summer of Code](#) several times (thanks to HSF!)
- ▶ **2020** selected by ATLAS as its official web event display



- ▶ **Open-source & experiment-agnostic by design**
- ▶ Extensible with “loaders” for many experiments
 - ▶ **Event data:** plain JSON, JiveXML, CMS, LHCb etc
 - ▶ **Geometry:** can load all 3D formats supported by threejs, plus ROOT + parametric representations
- ▶ Native support for many physics objects:
 - ▶ Tracks, Clusters, Jets, Hits, Muons, Photons etc
- ▶ Helper tools, such as a Runge-Kutta propagator
- ▶ Modern, powerful UI allowing:
 - ▶ Different ways to visualise physics data
 - ▶ Different ways to select and cut on this data
 - ▶ *And much more*
- ▶ Fast, works on mobiles devices
- ▶ Support for virtual and augmented reality on devices which support it...

```
var parameters = { ModuleName: "Module 3", Xdim: 10., Ydim: 1., Zdim: 45, NumPhiEl: 64, NumZEl: 10, Radius: 75, MinZ: -250, MaxZ: 250, TiltAngle: 0.3, PhiOffset: 0.0, Colour: 0x00ff00, EdgeColour: 0x449458 };  
  
window.eventDisplay.buildGeometryFromParameters(parameters);
```



PHOENIX IN 2026: A MAJOR GUI OVERHAUL

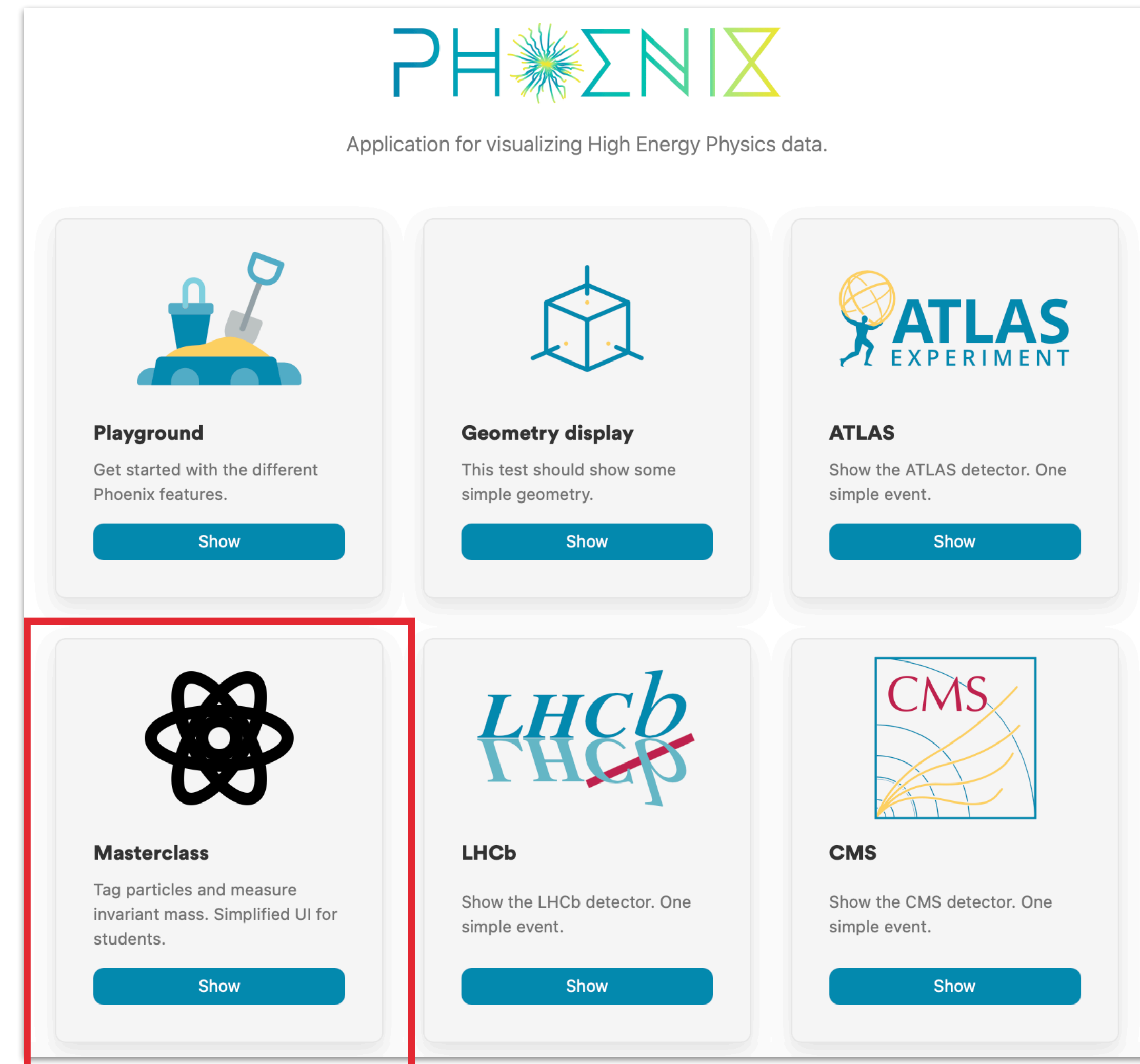
- ▶ Recently Phoenix has had a major GUI redesign ([v4.0](#), June 2026)
 - ▶ Many interface improvements, bug fixes
 - ▶ Fully configurable UI via UIMenuConfig (allows experiments to better configure)
 - ▶ Migrated to Angular 20, with many WebGL/GPU memory-leak fixes - much more performant
- ▶ Powerful new panels
 - ▶ **Event Dataset Browser:** physics-aware event filtering
 - ▶ **Track Kinematics Panel:** config-driven columns, click to zoom to object
 - ▶ **Eta-phi energy maps** for calorimeter data, tracks, jets
- ▶ Sharing & pictures
 - ▶ URL deep-linking for shareable view states (make it look good, share with colleagues)
 - ▶ New tiled screenshot rendering for very large images
 - ▶ Download animations directly - no need for external tools to screen grab
- ▶ **More support for ATLAS datasets**
 - ▶ Native support for PHYSLITE, xAOD, ESD etc (though only for objects that store global coordinates i.e. no hits etc)



NEW: A DEDICATED MASTERCLASS PANEL

6

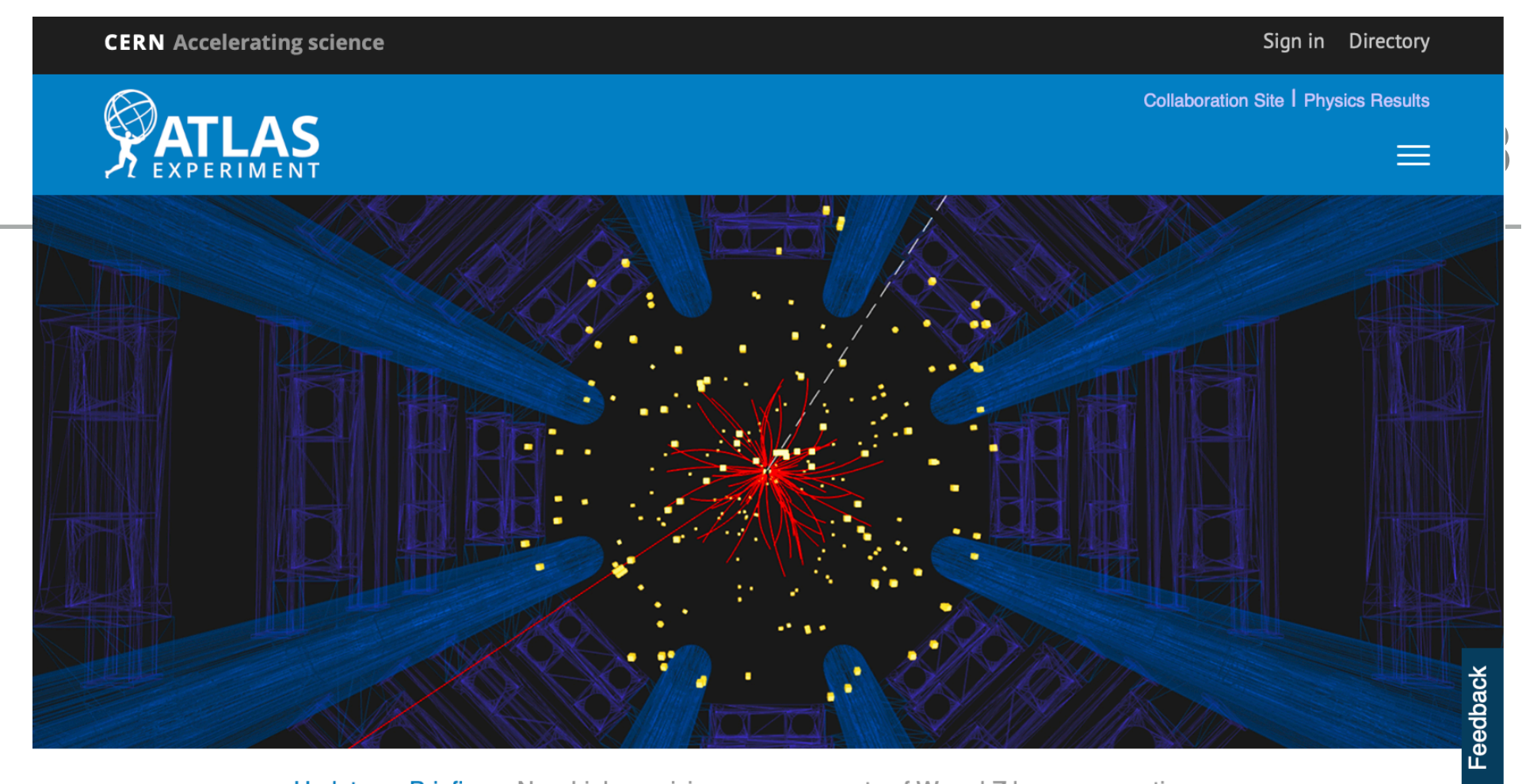
- ▶ A purpose-built demo: "Tag particles and measure invariant mass. Simplified UI for students."
 - ▶ A simpler ATLAS Masterclass landing page, distinct from the full expert interface
- ▶ Intent is to have a guided workflow
 - ▶ Select tracks from a real event (each one listed with its p_T and η)
 - ▶ Later steps build up to tagging particles and calculating an invariant mass by hand
 - ▶ Can export results to use in other tools
- ▶ Uses the same Event Dataset Browser and Track Kinematics Panel as the main GUI
- ▶ **Caveat:** this was not developed by people with experience of masterclasses, **so feedback/advice would be much appreciated!**



PHOENIX IN ATLAS

BRIEFINGS

- ▶ Many ATLAS physics briefings include an embedded interactive example event
- ▶ Great way to help visualise what is being explained in the text
- ▶ e.g.
 - ▶ [New high-precision measurements of W and Z boson properties](#)
 - ▶ [Not a jet all the way: is dark matter hiding in plain sight?](#)
 - ▶ [ATLAS turns into a cosmic-ray laboratory with proton-oxygen collisions](#)



[Updates](#) > [Briefing](#) > New high-precision measurements of W and Z boson properties

Physics Briefing

Tags:
[W boson](#),
[Z boson](#),
[physics results](#),
[LHCP 2023](#)

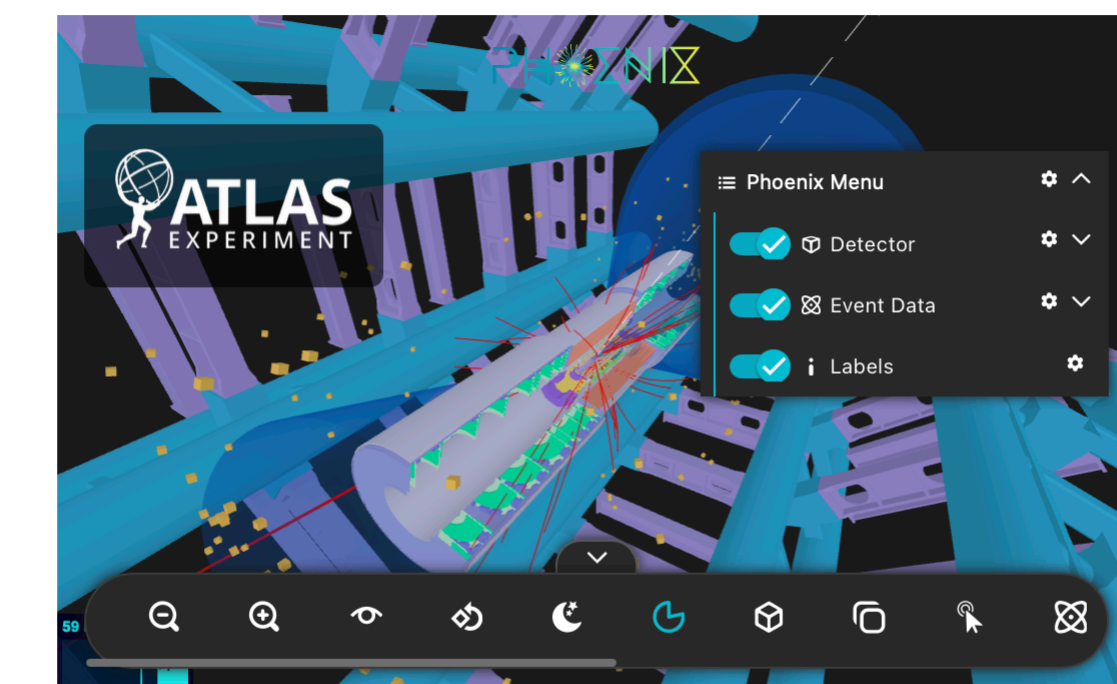
New high-precision measurements of W and Z boson properties

A major milestone towards more precise measurements of the W-boson mass

25 May 2023 | By [ATLAS Collaboration](#)

Ever since their discovery at CERN in the 1980s, the $W^\pm$ and Z bosons have been the subject of extensive research. As the carriers of the weak force, measurements of their properties are crucial for understanding elementary interactions. For instance, [measurements of the W-boson mass](#) are a critical test of

Explore the interactive event display



Dynamic view of a W-boson candidate decaying to one muon (red line) and one neutrino (missing transverse momentum, dashed line). (Image: ATLAS Collaboration/CERN)

[Learn more](#)

LIVE VIEW

- ▶ ATLAS has a [live page](#), show a selection of recent public events
- ▶ Internal [page](#) allows you to select the stream
 - ▶ Obviously none of which are very active at the moment...
- ▶ Can open an atlantis static view, or interactive Phoenix view
- ▶ (No guarantee that the event is very interesting!)

Latest ATLAS events

select trigger stream » current trigger stream: Public

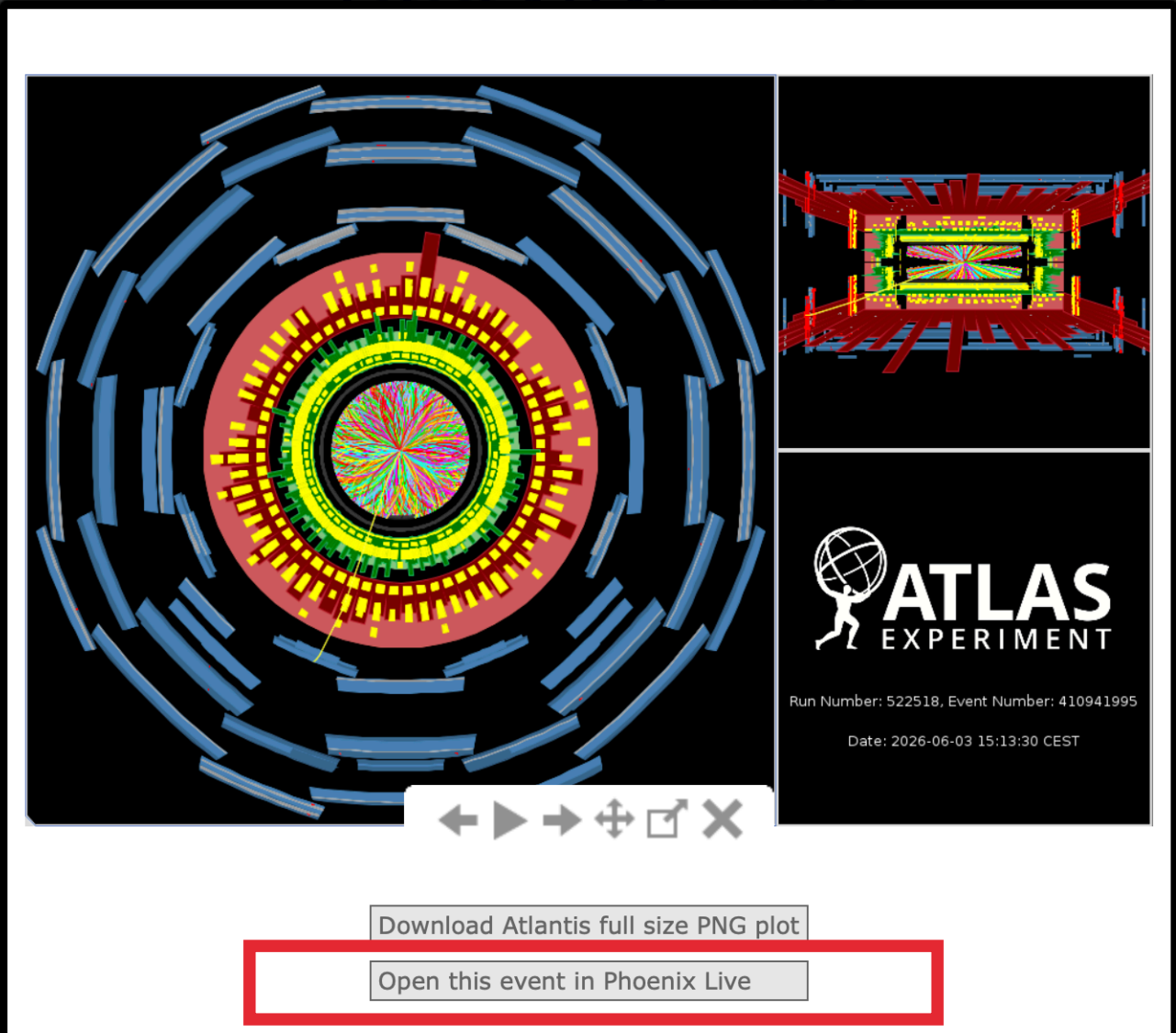


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

[latest event page for this trigger stream](#) [ATLAS Collaboration internal site](#)

last event run number: 522546 event number: 1089848953

select trigger stream



ATLAS EXPERIMENT

Run Number: 522518, Event Number: 410941995

Date: 2026-06-03 15:13:30 CEST

Download Atlantis full size PNG plot

Open this event in Phoenix Live

last event run number: 522546 event number: 1089848953

- ▶ Phoenix is also used to visualise some of the ATLAS Open Data
- ▶ [Tutorial](#) explains how to do this, together with some prepared examples to look at

JSON examples

If you would like to explore more event types, we have provided JSON files for various physics processes. You can download these JSON files and open them in Phoenix to visualize the events.

- **Top Quark Events**
 - [Standard Model ttbar Production \(non-all-hadronic\)](#)
 - [Triple Top Production](#)
- **Weak Boson Events**
 - [ZZZ Production \(4 leptons and 2 neutrinos\)](#)
- **Jet Events**
 - [High Jet Multiplicity Events](#)
 - [Low Jet Multiplicity Events](#)
- **Higgs Events**
 - [tH Production with \$H \rightarrow ZZ \rightarrow 4l\$](#)
 - [ttH Production with \$H \rightarrow 4l\$, ttbar Dileptonic Decay](#)

Transforming Datasets into JSON

JSON examples

Short Usage Guide

 **ATLAS Open Data**

Get Started

Data

Tutorials ▼

Python API

Documentation

About us

Help ▼

Tutorials for Research ▼

Using the PHYSLITE Format

Using the Open Event Generation Data

Getting Started with Containers for Analysis

Phoenix for Event Visualisation

Exploring Public Likelihoods

Community Contributions

ATLAS Open Data Derivation Framework

🏠 > Tutorials for Research > Phoenix for Event Visualisation

Phoenix for Event Visualisation

🌟 Open

Web App

🔗 Open

Github Repo

Visualizing an event inside the detector opens a path to a deeper understanding of the physical processes resulting from a collision. One commonly used tool for event visualisation is [Phoenix](#), a framework that allows 3D visualisation of collision events inside the detector.



Phoenix Menu

☒ Detector

🔍

🔍

👁

🔄

🌙

🔄

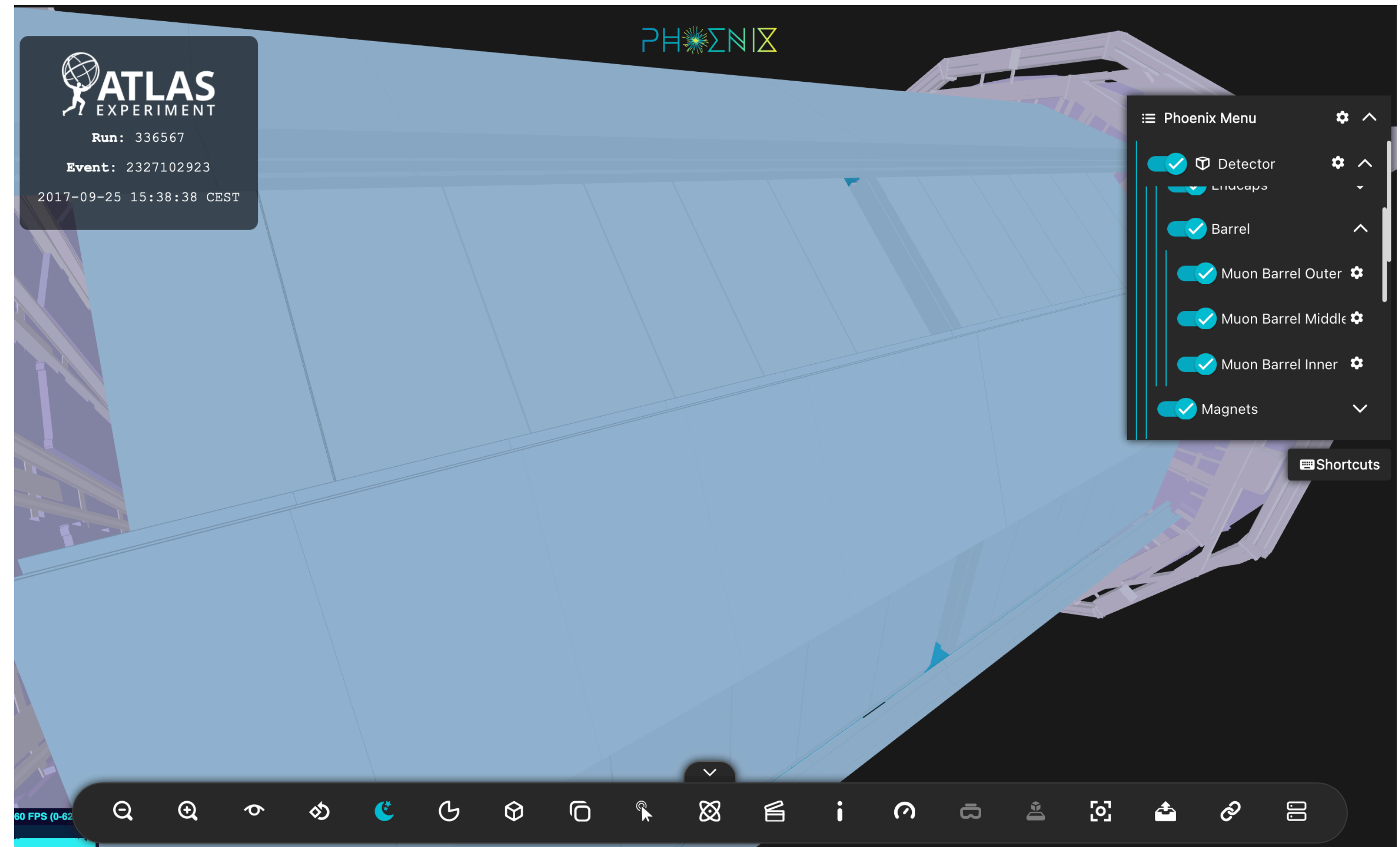
🏠

📄

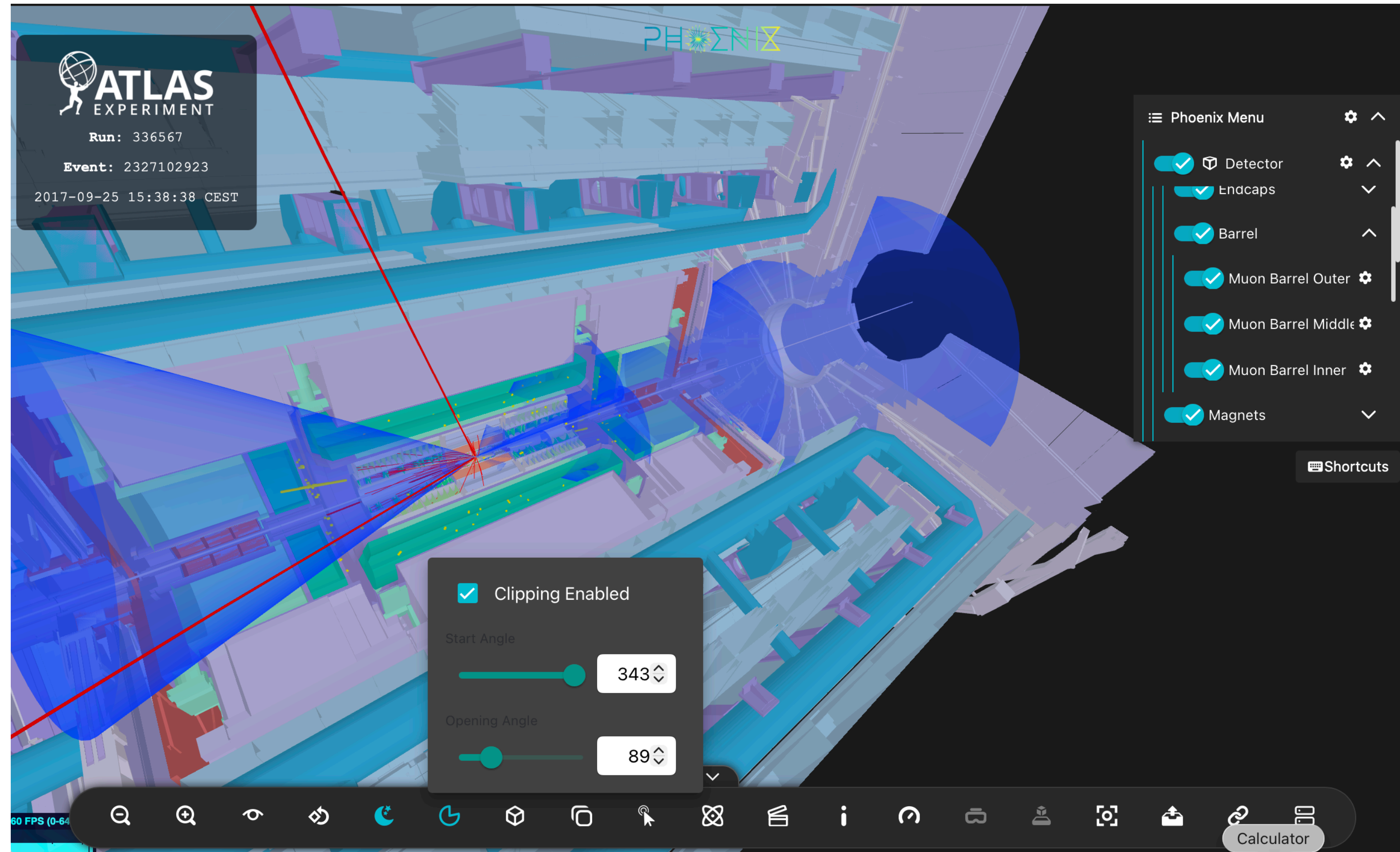
🖱

🔗

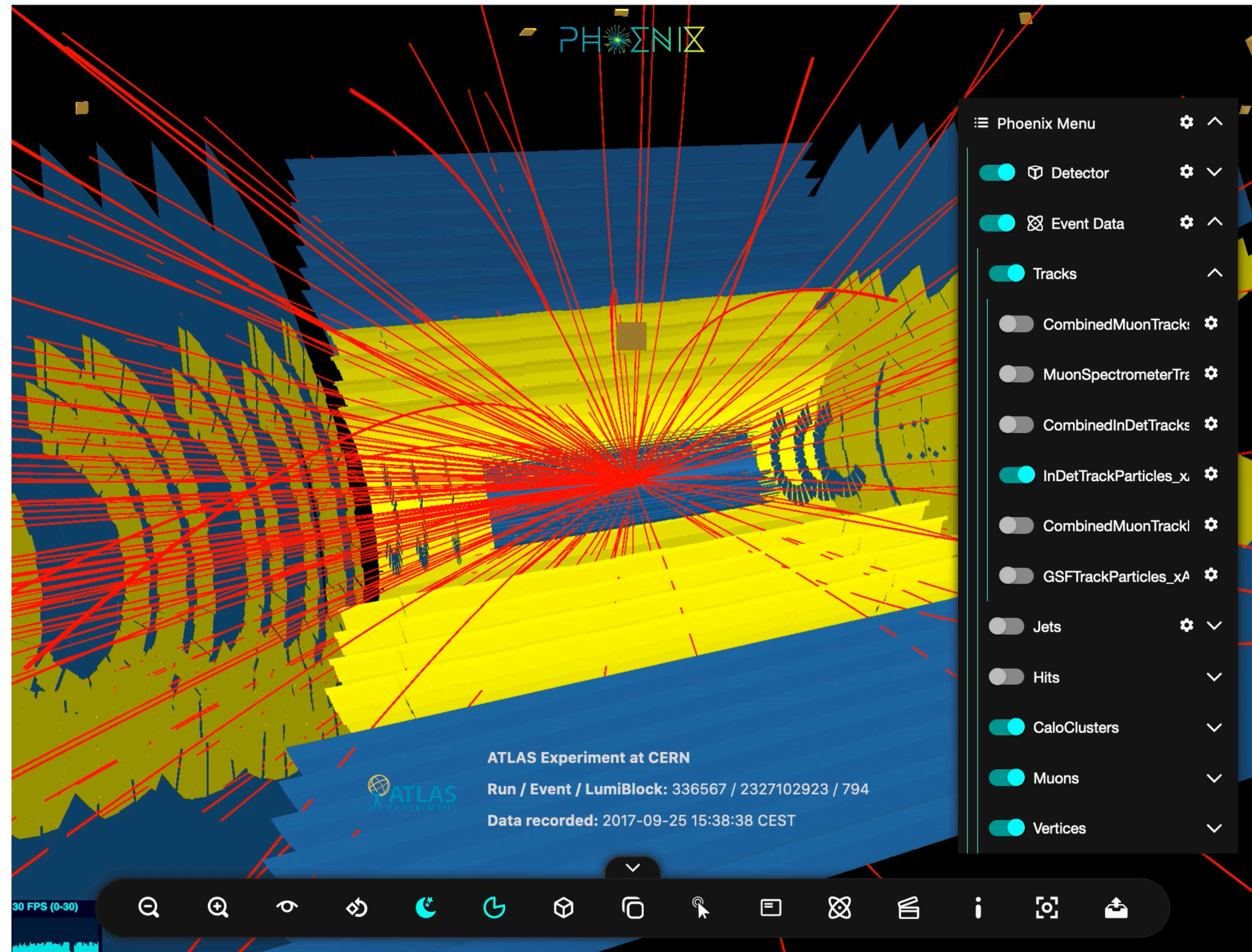
- ▶ In **ATLAS** [[link](#)], a default event is opened, and geometry is loaded
 - ▶ **Some geometry is hidden by default, but can be enabled**
 - ▶ How the geometry is rendered can be changed (and it can be sliced open)
 - ▶ Cuts can be applied to physics objects
 - ▶ Physics objects can be selected, further information displayed
 - ▶ Or you can search through a collection and find the objects this way
 - ▶ You can have an overlay view
 - ▶ And we have some builtin animations
- ▶ All of this configuration can be saved, loaded again, applied by default or passed in by URL



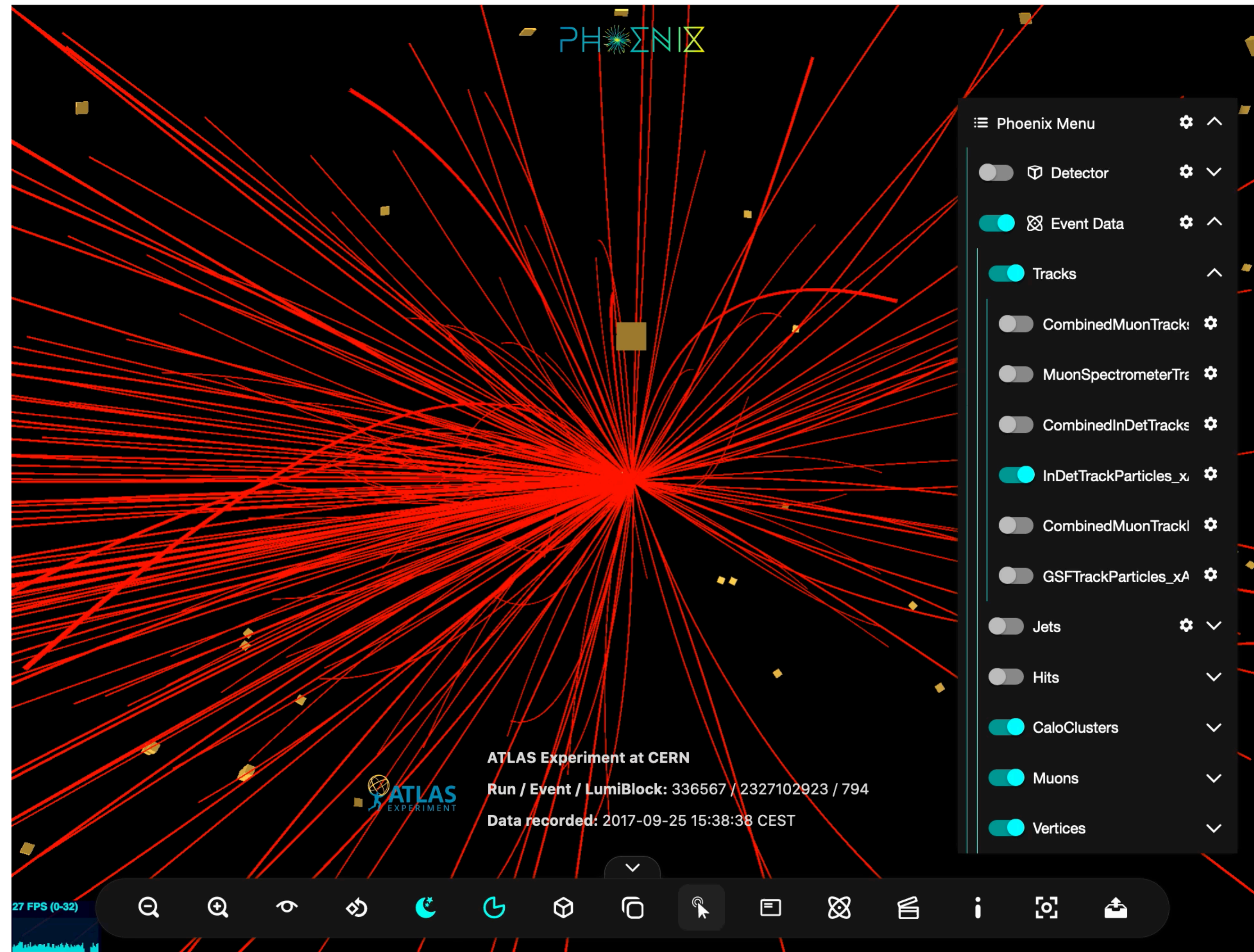
- ▶ In **ATLAS** [[link](#)], a default event is opened, and geometry is loaded
 - ▶ Some geometry is hidden by default, but can be enabled
 - ▶ **How the geometry is rendered can be changed (and it can be sliced open)**
 - ▶ Cuts can be applied to physics objects
 - ▶ Physics objects can be selected, further information displayed
 - ▶ Or you can search through a collection and find the objects this way
 - ▶ You can have an overlay view
 - ▶ And we have some builtin animations
- ▶ All of this configuration can be saved, loaded again, applied by default or passed in by URL



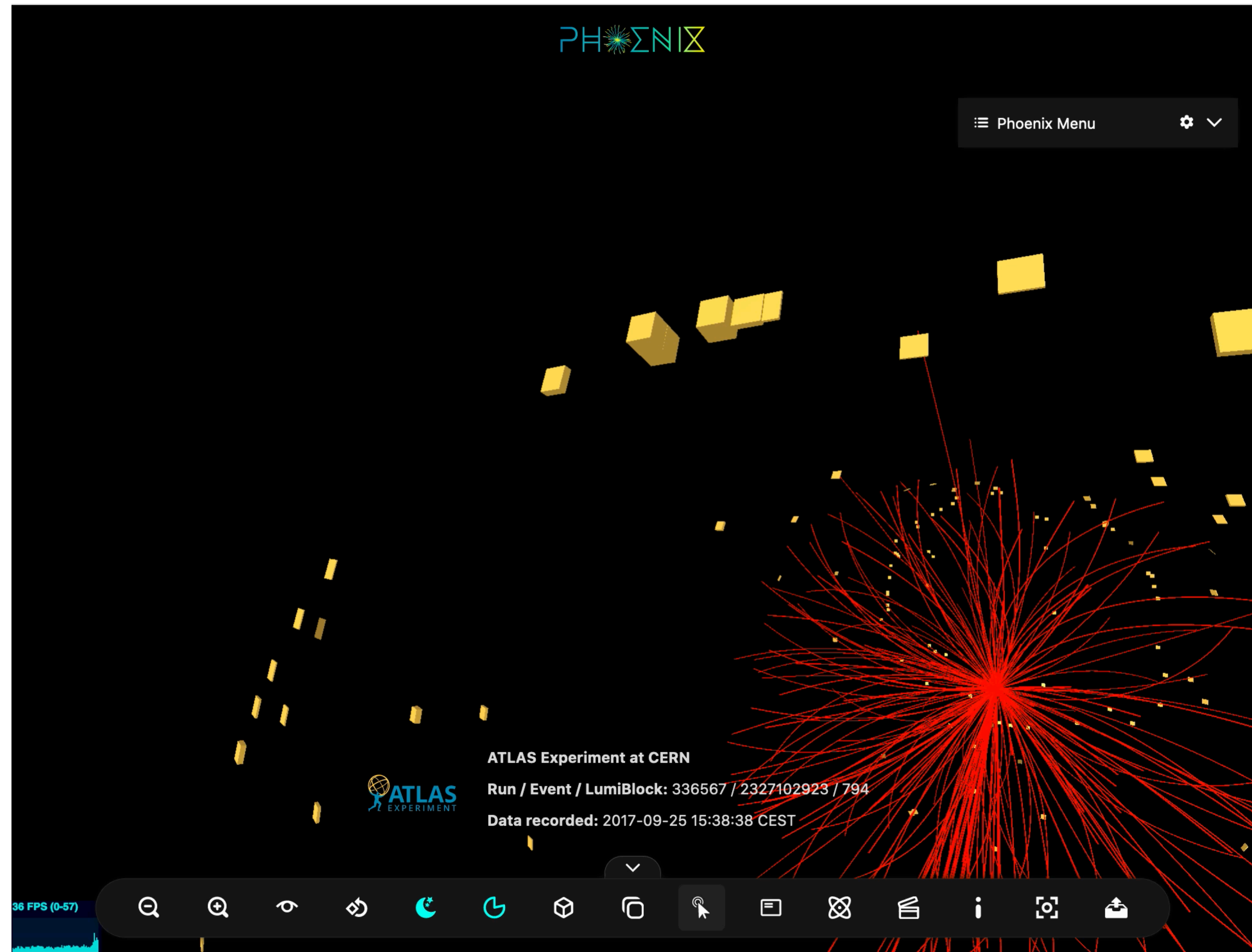
- ▶ In **ATLAS** [[link](#)], a default event is opened, and geometry is loaded
 - ▶ Some geometry is hidden by default, but can be enabled
 - ▶ How the geometry is rendered can be changed (and it can be sliced open)
 - ▶ **Cuts can be applied to physics objects**
 - ▶ Physics objects can be selected, further information displayed
 - ▶ Or you can search through a collection and find the objects this way
 - ▶ You can have an overlay view
 - ▶ And we have some builtin animations
- ▶ All of this configuration can be saved, loaded again, applied by default or passed in by URL



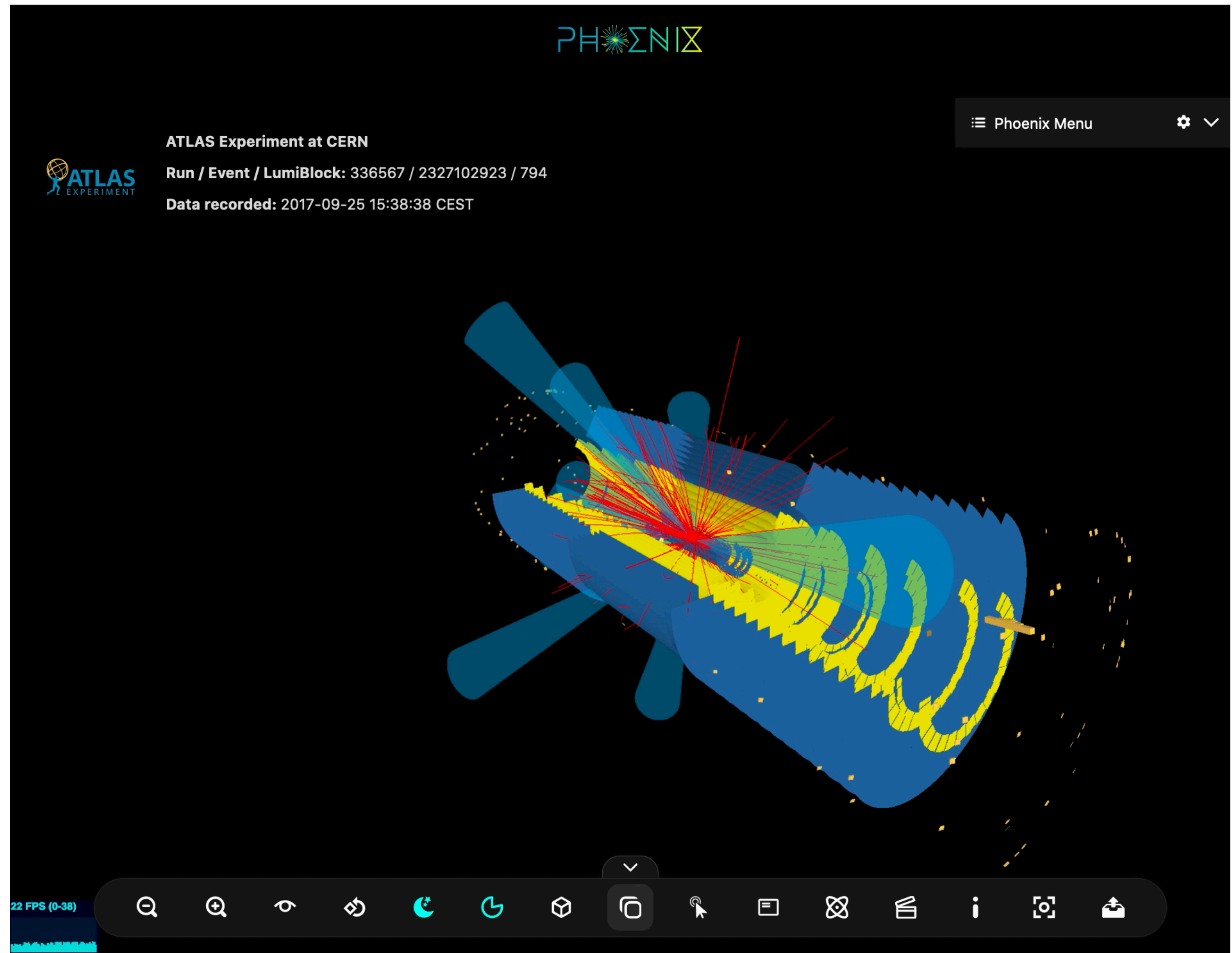
- ▶ In **ATLAS** [[link](#)], a default event is opened, and geometry is loaded
 - ▶ Some geometry is hidden by default, but can be enabled
 - ▶ How the geometry is rendered can be changed (and it can be sliced open)
 - ▶ Cuts can be applied to physics objects
 - ▶ **Physics objects can be selected, further information displayed**
 - ▶ Or you can search through a collection and find the objects this way
 - ▶ You can have an overlay view
 - ▶ And we have some builtin animations
- ▶ All of this configuration can be saved, loaded again, applied by default or passed in by URL



- ▶ In **ATLAS** [[link](#)], a default event is opened, and geometry is loaded
 - ▶ Some geometry is hidden by default, but can be enabled
 - ▶ How the geometry is rendered can be changed (and it can be sliced open)
 - ▶ Cuts can be applied to physics objects
 - ▶ Physics objects can be selected, further information displayed
 - ▶ **Or you can search through a collection and find the objects this way**
 - ▶ You can have an overlay view
 - ▶ And we have some builtin animations
- ▶ All of this configuration can be saved, loaded again, applied by default or passed in by URL



- ▶ In **ATLAS** [[link](#)], a default event is opened, and geometry is loaded
 - ▶ Some geometry is hidden by default, but can be enabled
 - ▶ How the geometry is rendered can be changed (and it can be sliced open)
 - ▶ Cuts can be applied to physics objects
 - ▶ Physics objects can be selected, further information displayed
 - ▶ Or you can search through a collection and find the objects this way
 - ▶ **You can have an overlay view**
 - ▶ And we have some builtin animations
- ▶ All of this configuration can be saved, loaded again, applied by default or passed in by URL



- ▶ The masterclass demo
 - ▶ hepsoftwarefoundation.org/phoenix – click “Masterclass” for the masterclass demo
 - ▶ Or go have a look ATLAS instance at phoenixatlas.web.cern.ch, or one of the [other](#) experiment specific examples e.g. [Belle2](#), [LHCb](#), [FCC](#)
- ▶ No installation needed – it runs entirely in your browser

- ▶ User & developer guides mostly live in the main phoenix [repo](#)
 - ▶ (ATLAS [one](#) is more on e.g how to make a briefing)
- ▶ Get help:
 - ▶ Report issues on [phoenix/phoenixatlas](#) GitHub sites
 - ▶ For questions, can use GitHub [Discussions](#)
- ▶ Contributions welcome – the codebase is fully open source!



- ▶ Phoenix is a well-established framework for visualising HEP events, used by several experiments
 - ▶ Help is always welcomed (entirely developed by volunteers)
 - ▶ **Any feedback on masterclass functionality would be great**
 - ▶ If I find time, I'd really like to work on VR/AR this year

