

CERN

Where the Infinitely Large Meets the infinitely small

João Silva

Derek Mathieson

Software Engineer and Java Practice Lead at
CERN's Business Computing Group


the
BIG BANG
THEORY

CERN



Like a Small Town

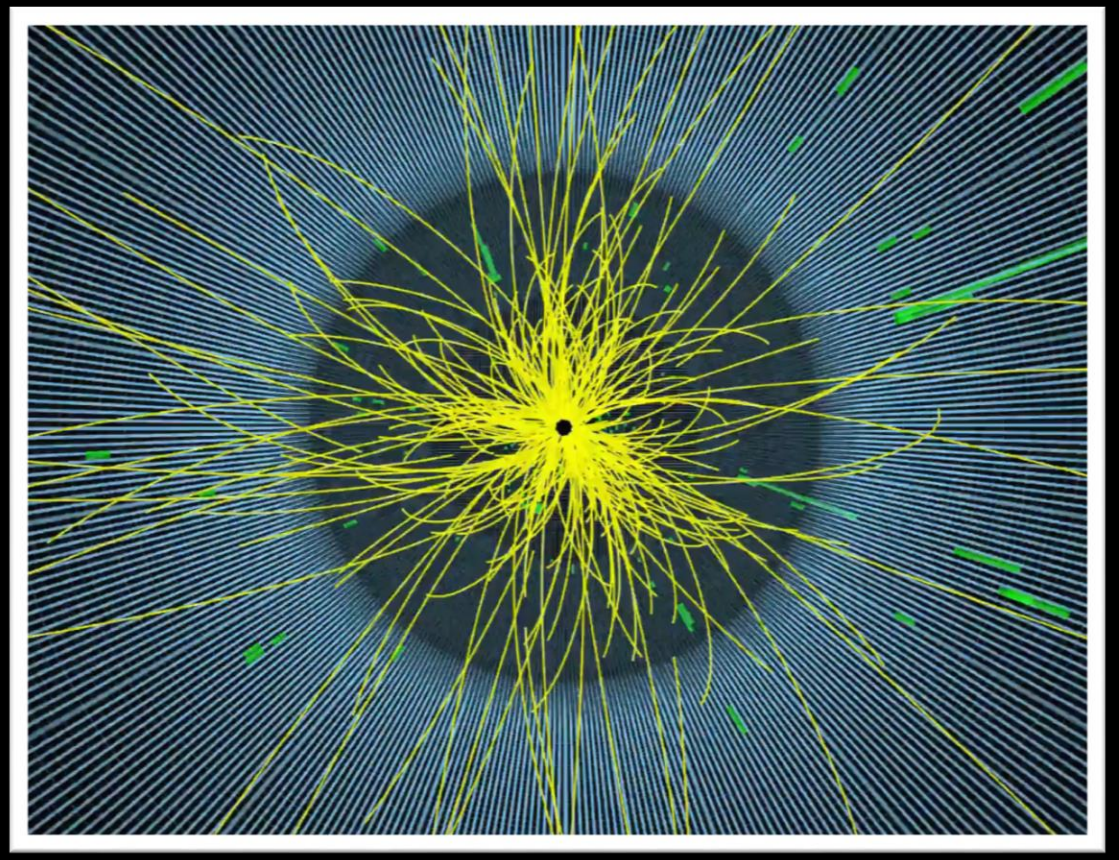


A Unique Place



A Unique Place

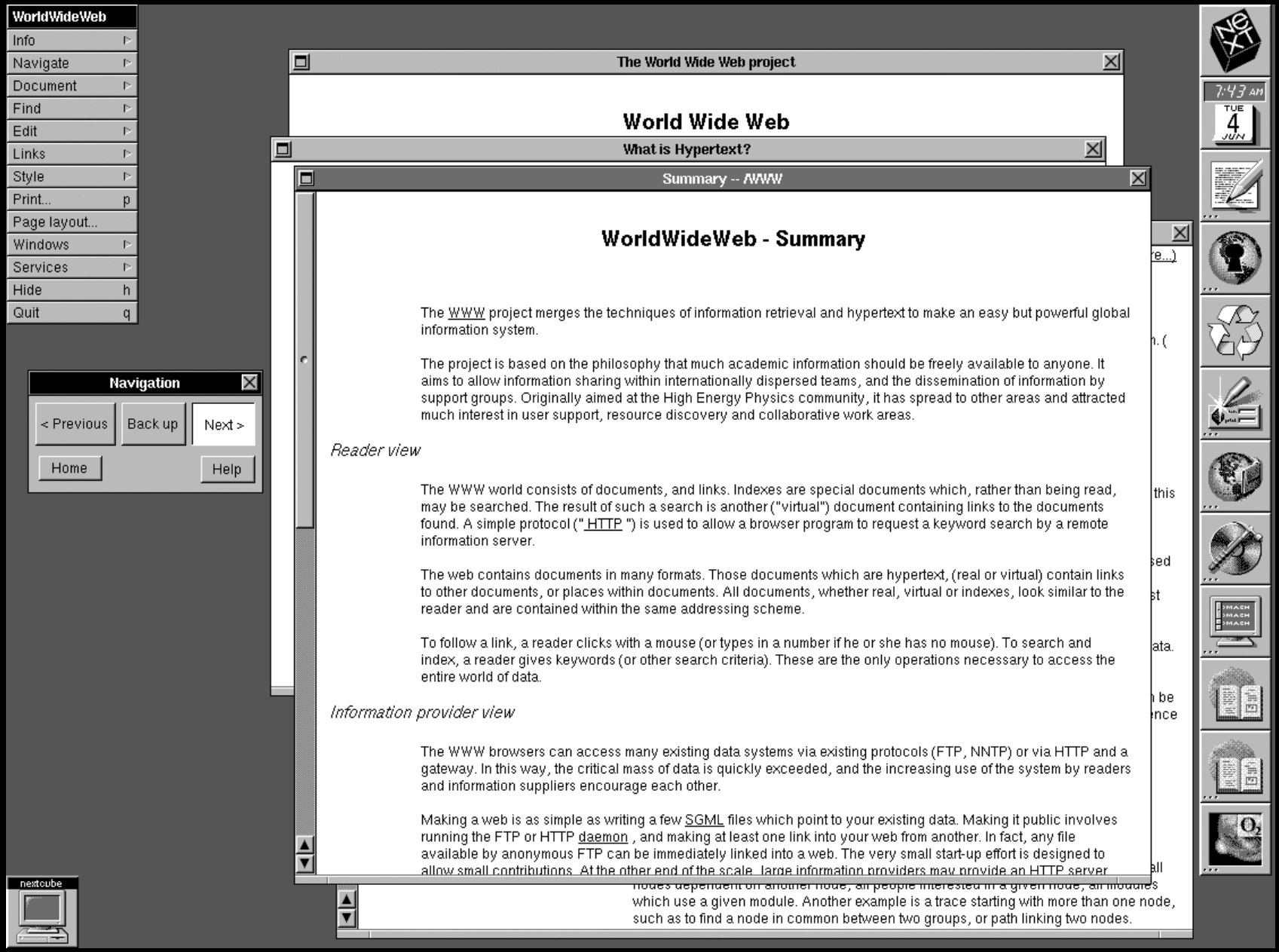




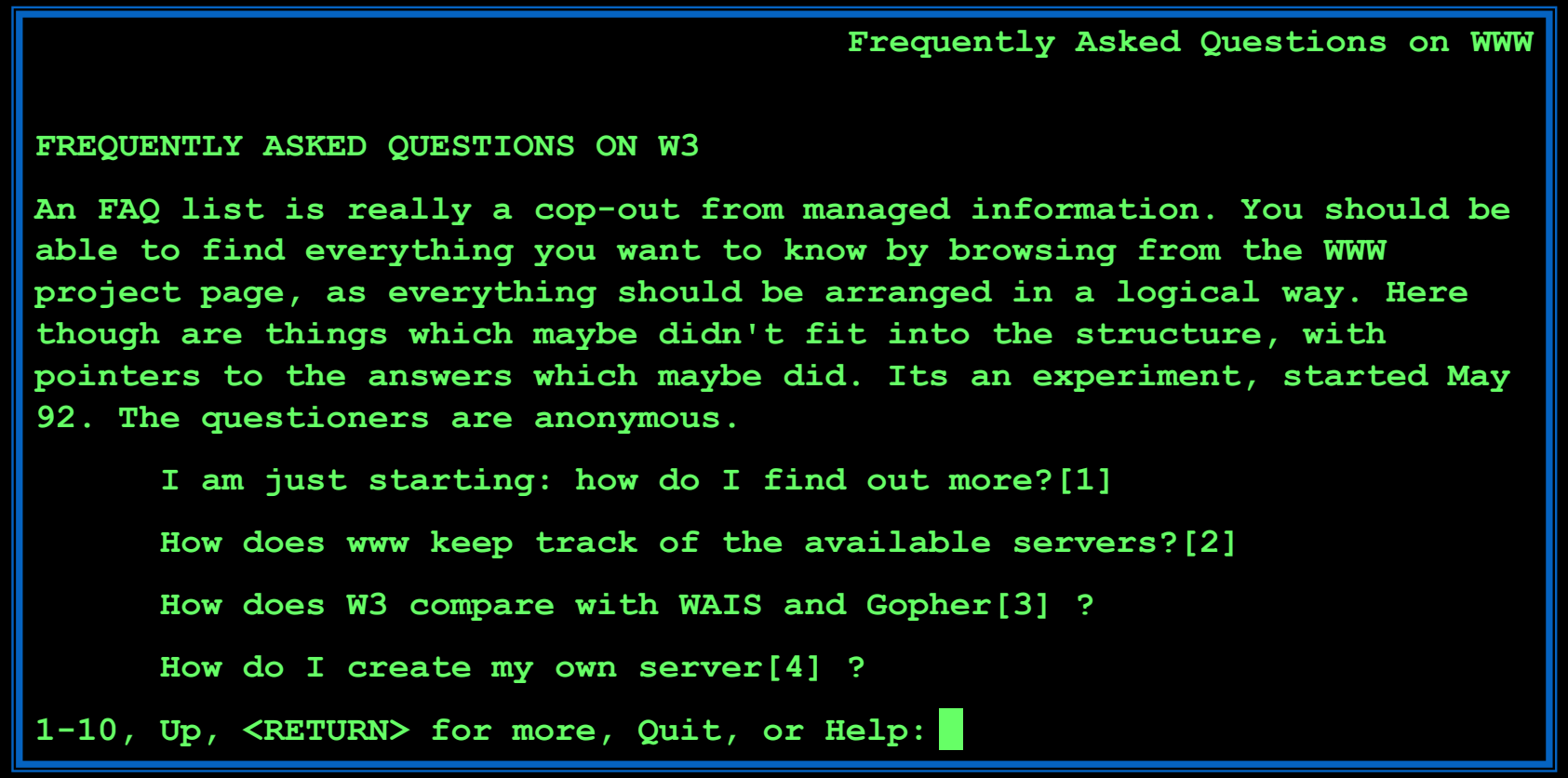
Worldwide Collaboration



The Web in 1990



The Web in 1990



```
                                        Frequently Asked Questions on WWW


FREQUENTLY ASKED QUESTIONS ON W3

An FAQ list is really a cop-out from managed information. You should be
able to find everything you want to know by browsing from the WWW
project page, as everything should be arranged in a logical way. Here
though are things which maybe didn't fit into the structure, with
pointers to the answers which maybe did. Its an experiment, started May
92. The questioners are anonymous.

      I am just starting: how do I find out more?[1]

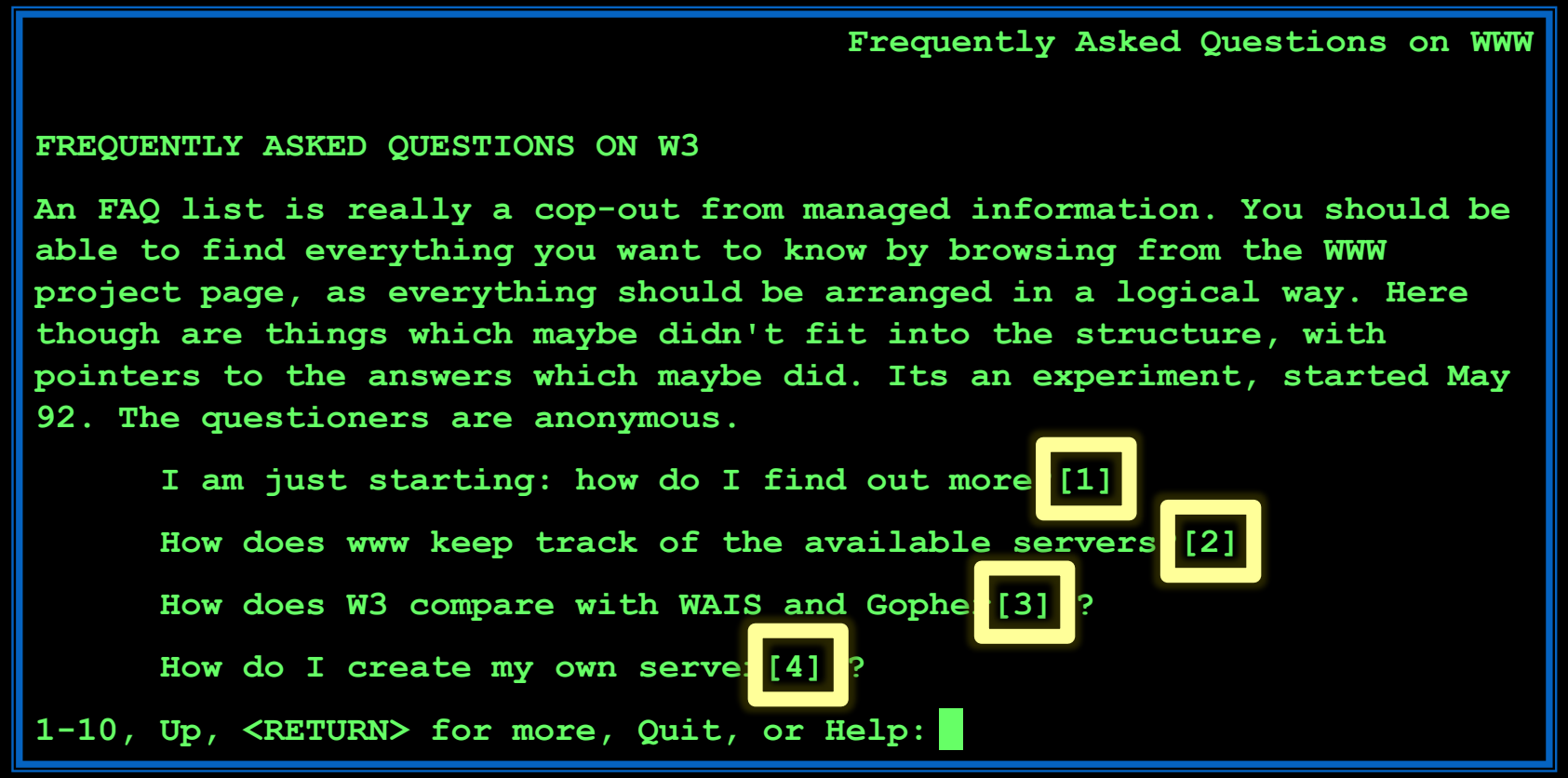
      How does www keep track of the available servers?[2]

      How does W3 compare with WAIS and Gopher[3] ?

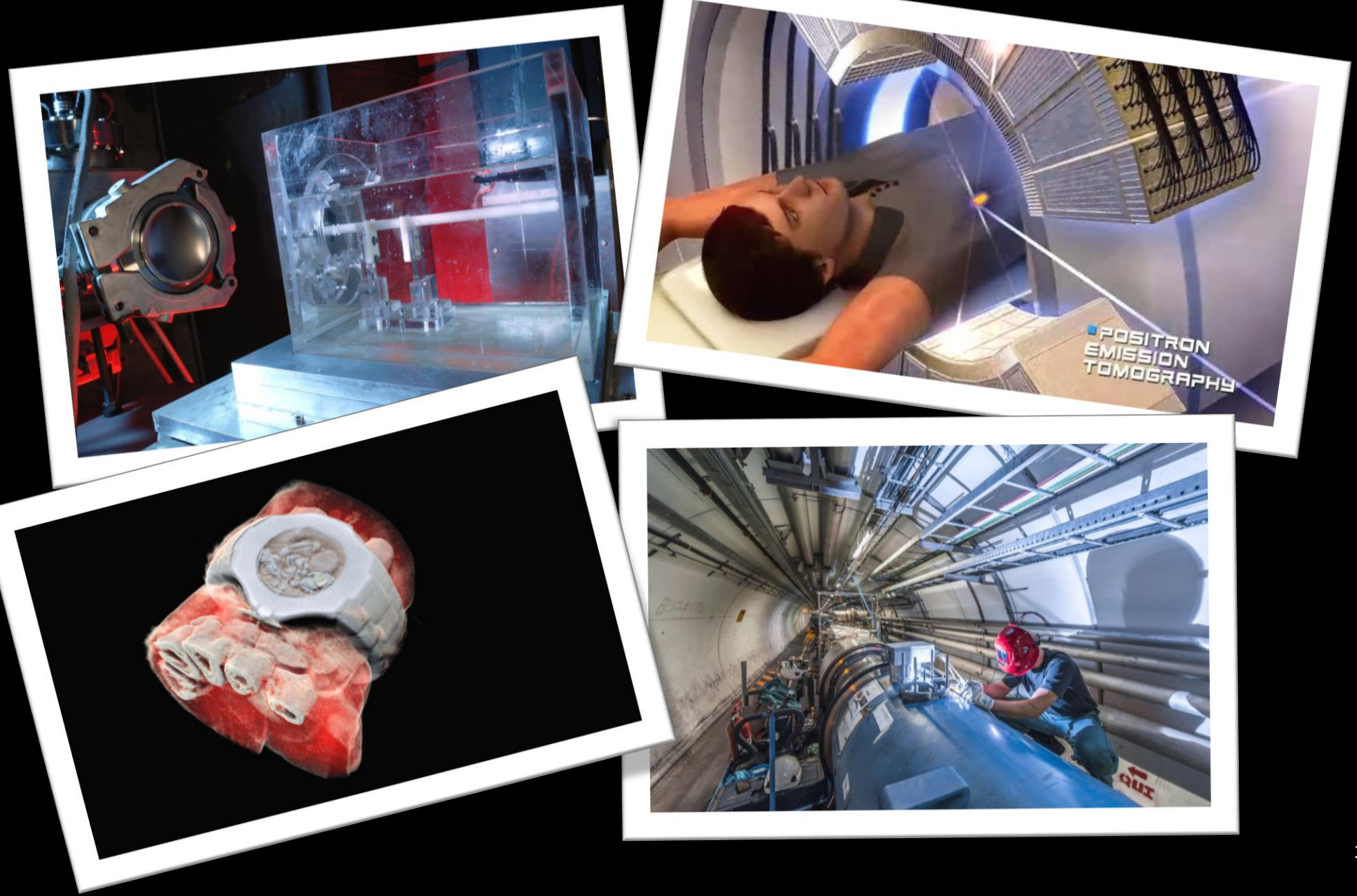
      How do I create my own server[4] ?

1-10, Up, <RETURN> for more, Quit, or Help:
```

The Web in 1990



CERN Innovates



CERN Innovates

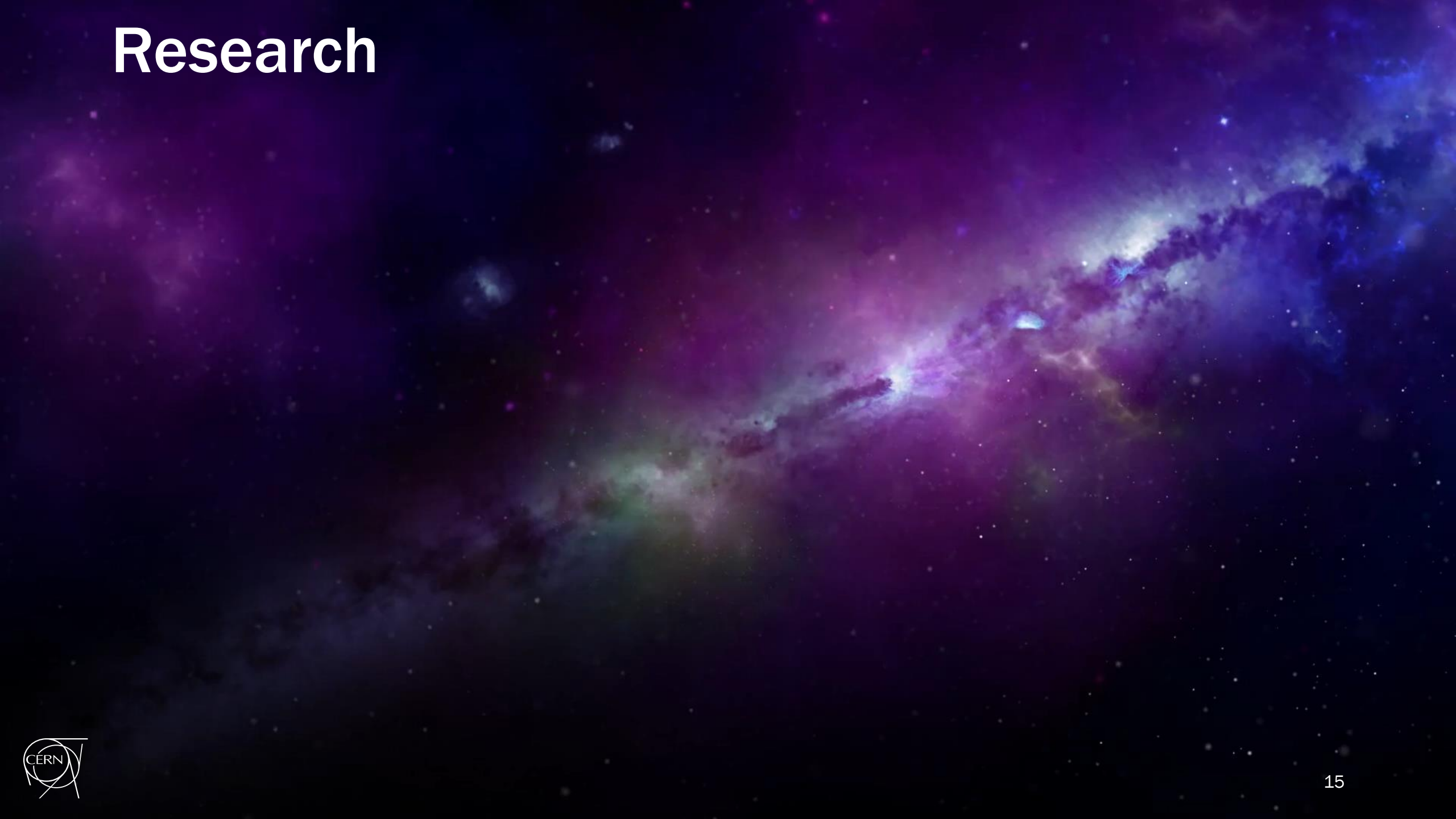


Research





Research

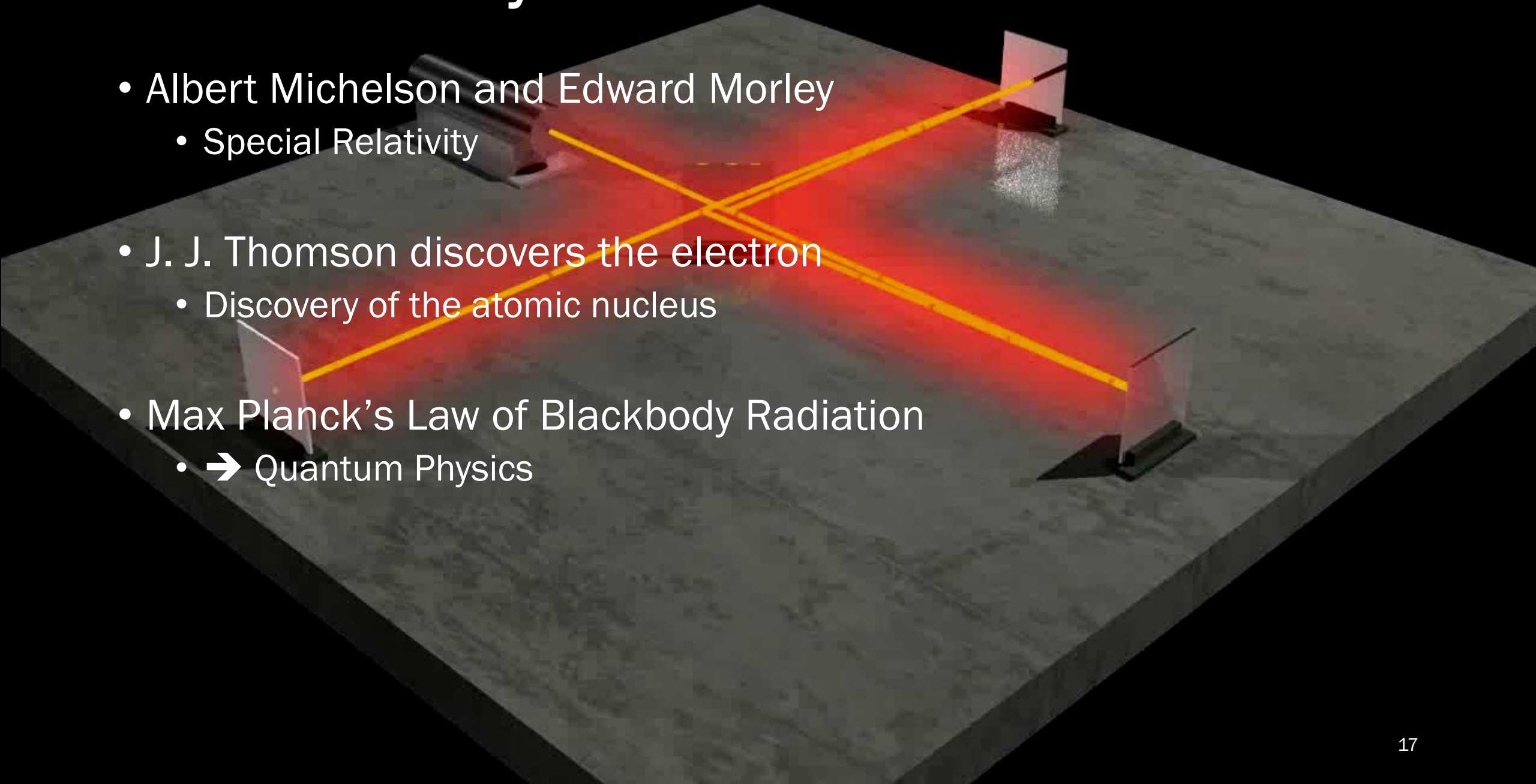


Some ‘History’

- Johannes Kepler (1571-1630)

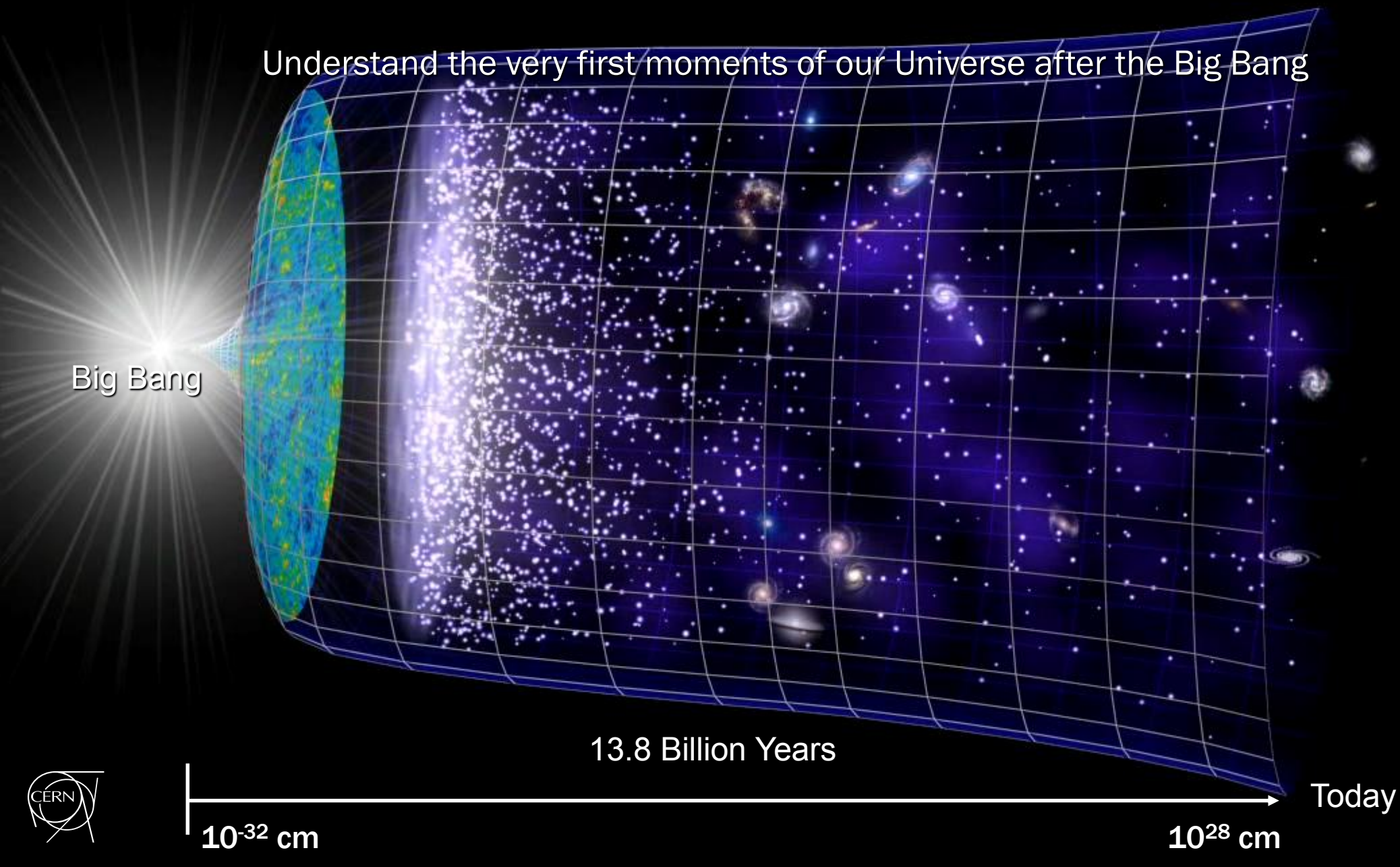
- Isaac Newton (1642-1727)

Some ‘History’



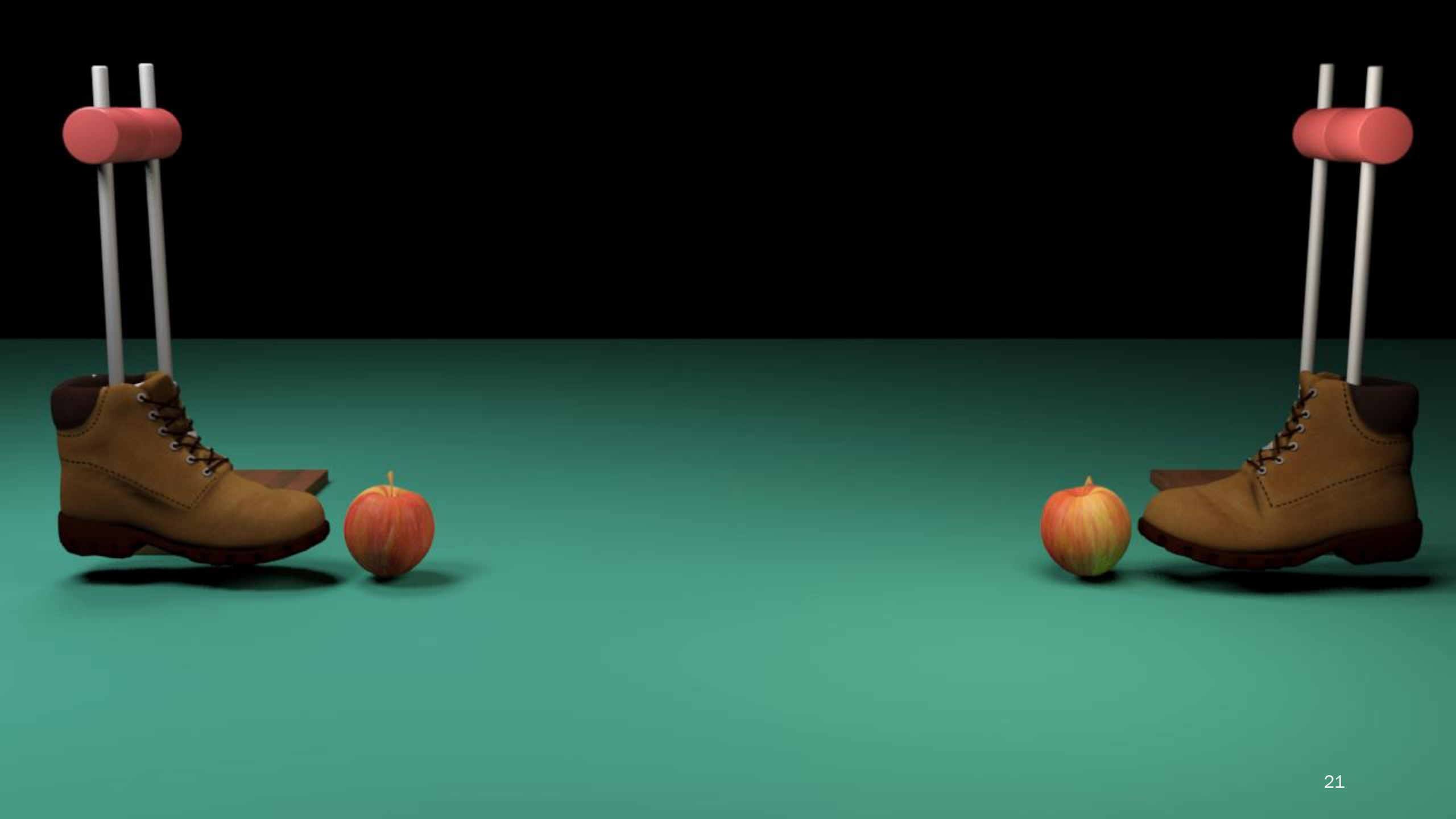
- Albert Michelson and Edward Morley
  - Special Relativity
- J. J. Thomson discovers the electron
  - Discovery of the atomic nucleus
- Max Planck’s Law of Blackbody Radiation
  - ➔ Quantum Physics

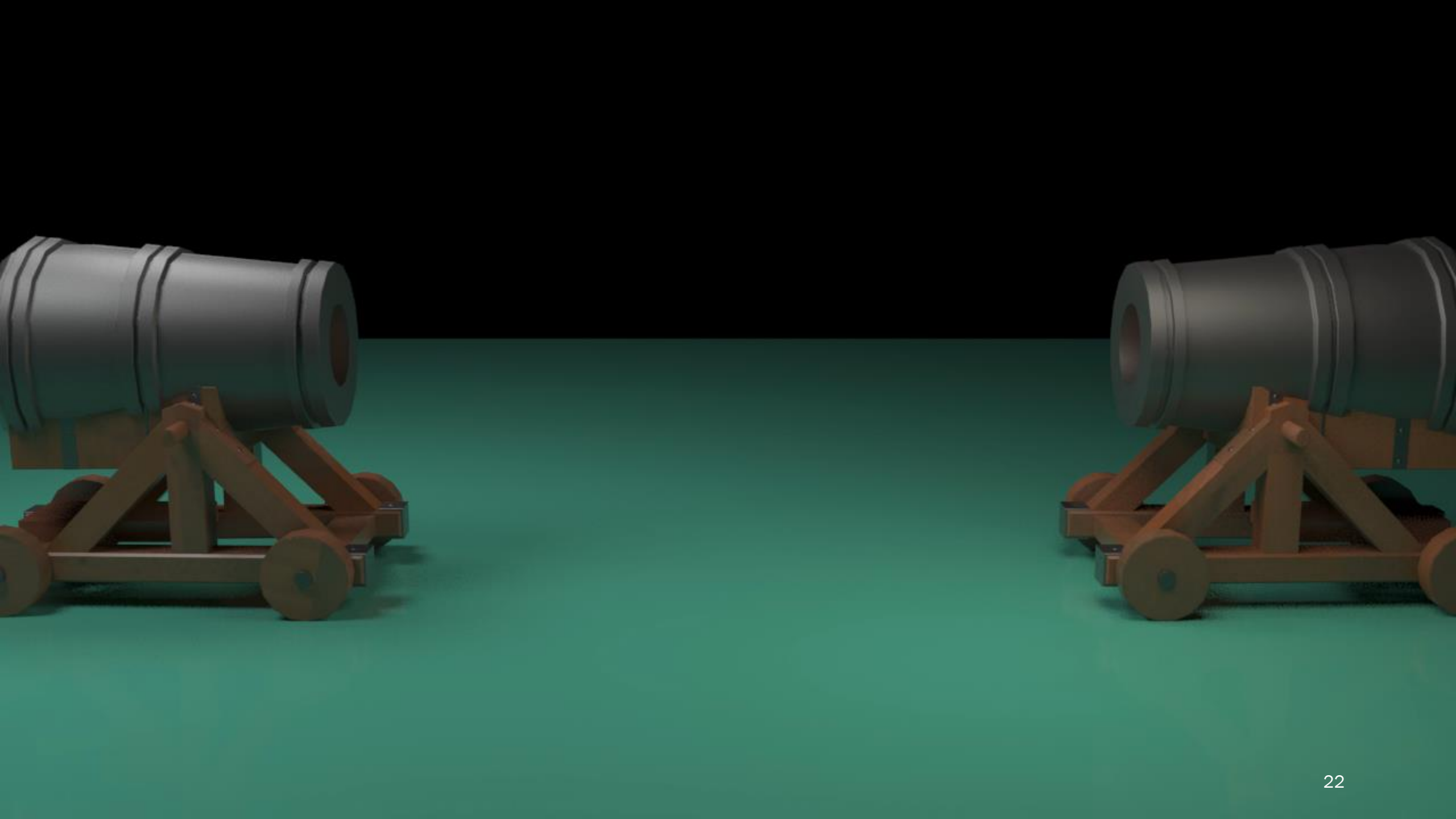
Next Scientific Challenge:



Particle Accelerator?

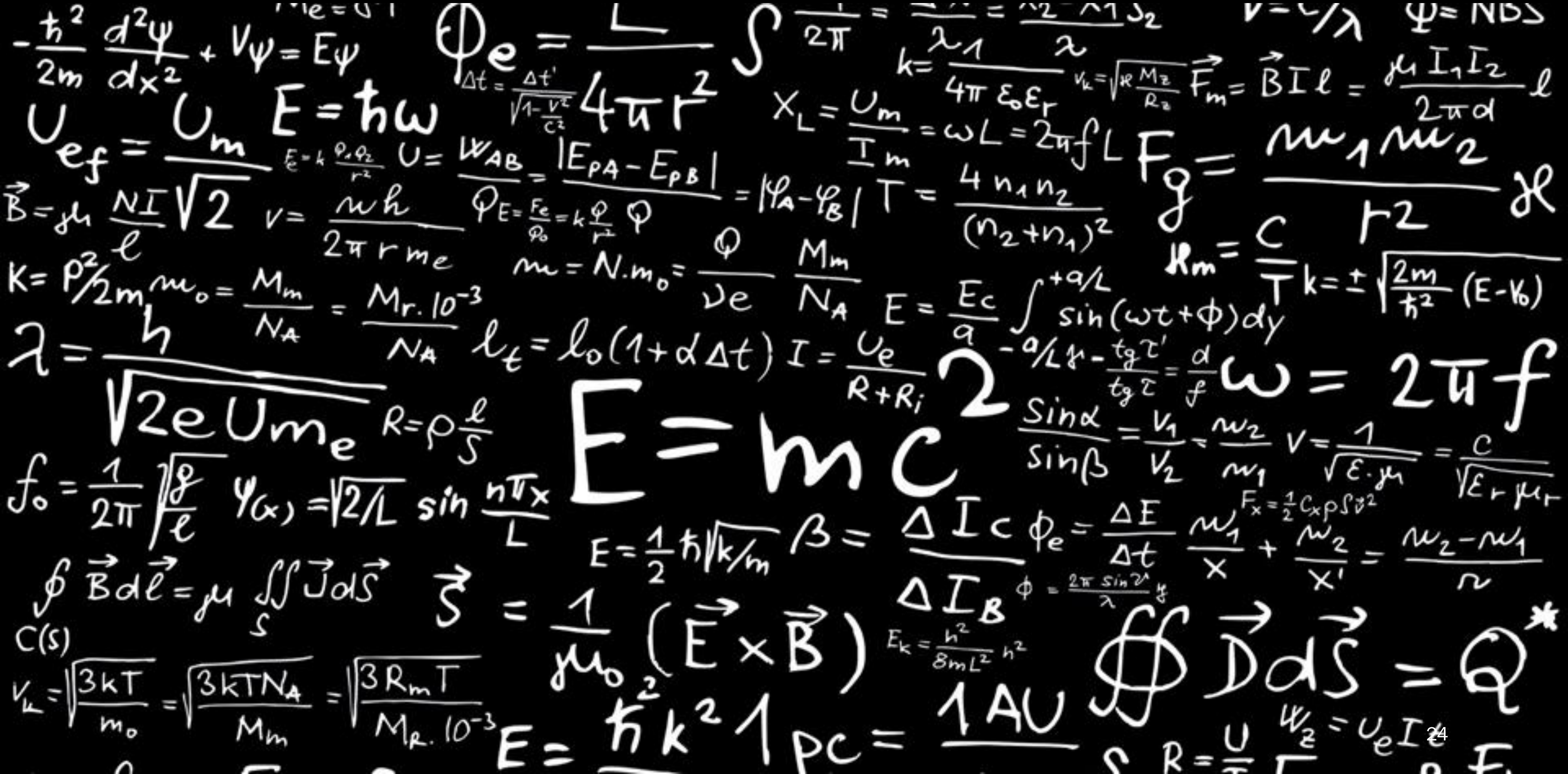








Incredible levels of energy

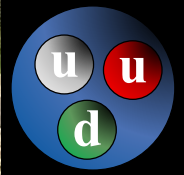


Incredible levels of energy

7 TeV



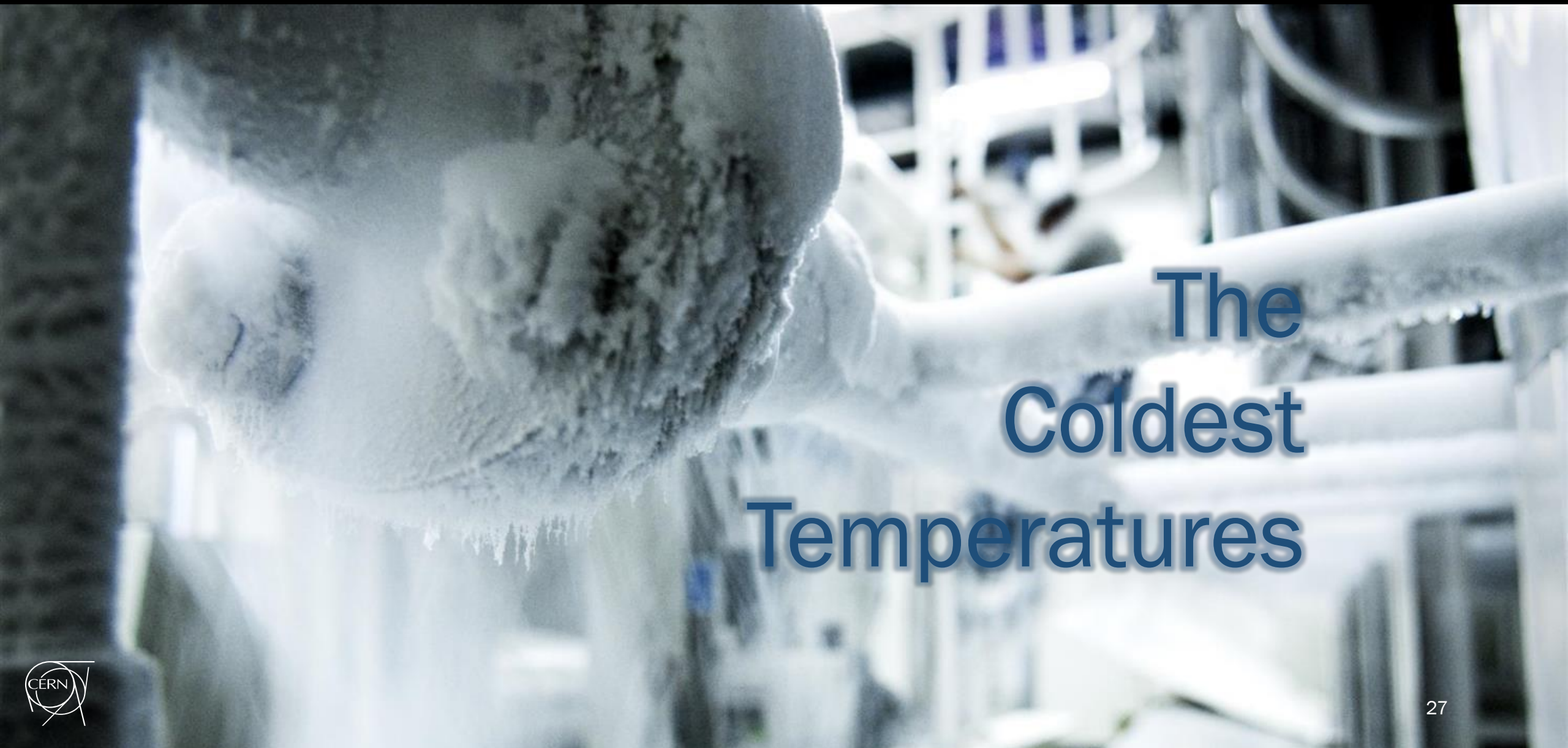
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Accelerator Chain



World-class technology…



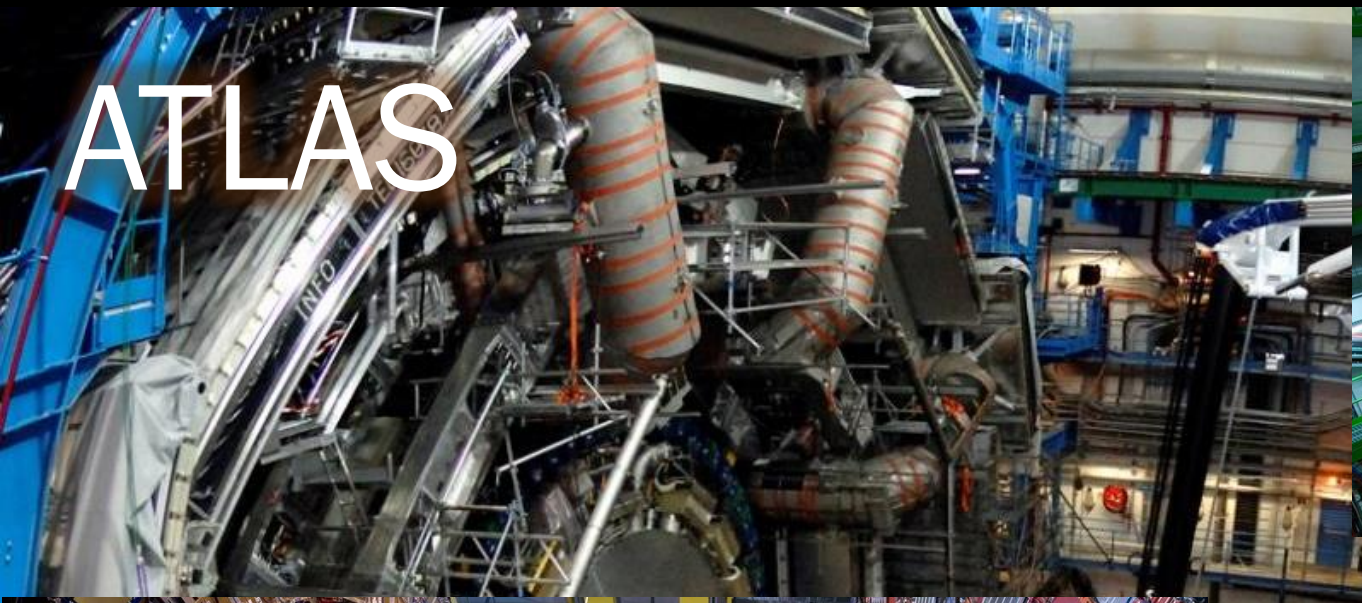
The LHC

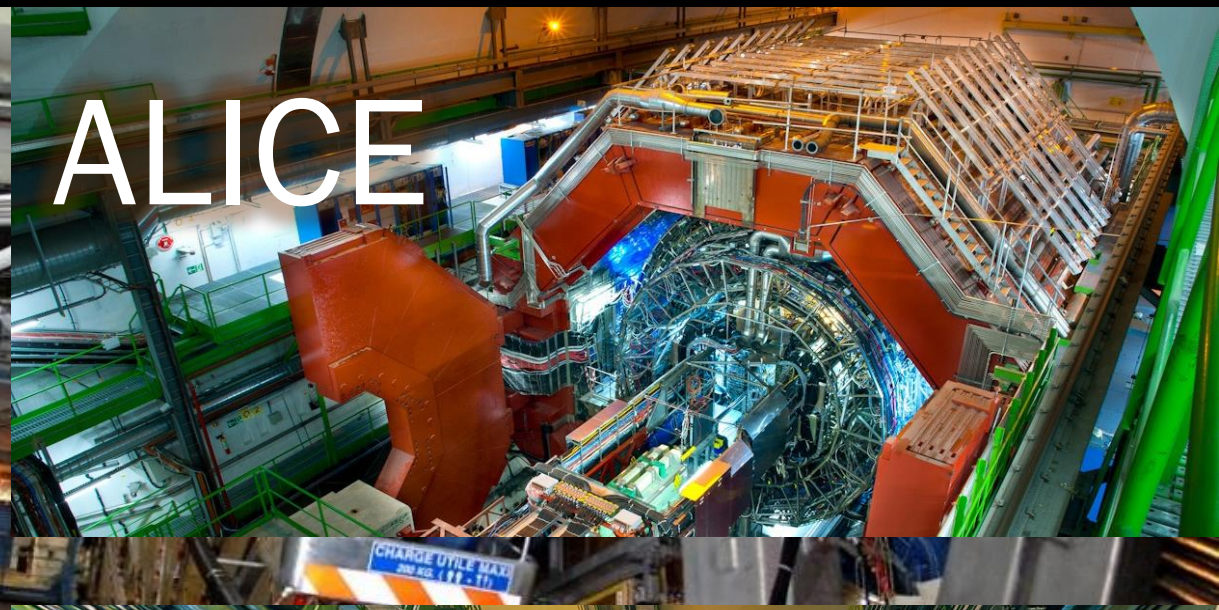

LHC
ATLAS
CERN Meyrin
CERN Prévessin
SPS 7 km
SUISSE
FRANCE
CMS
ALICE
LHC 27 km

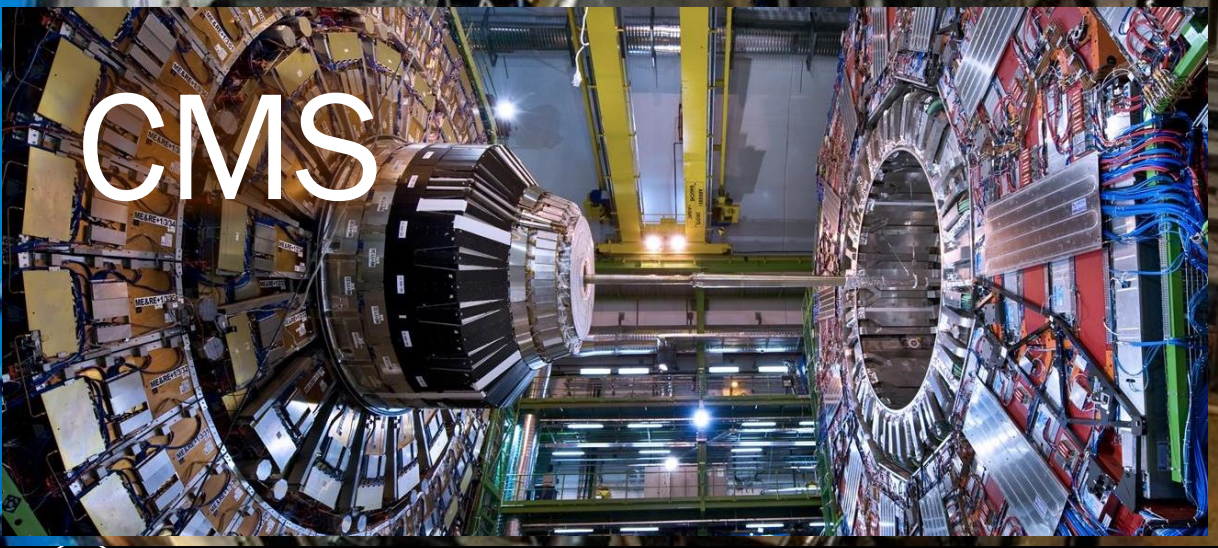
Particle Beams

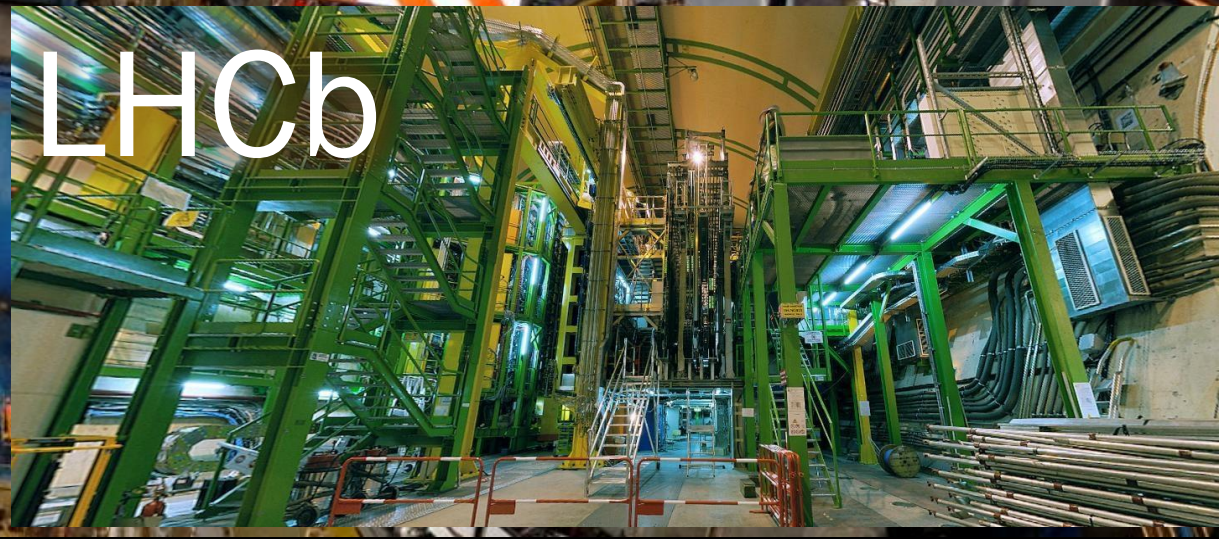


Particle Detectors





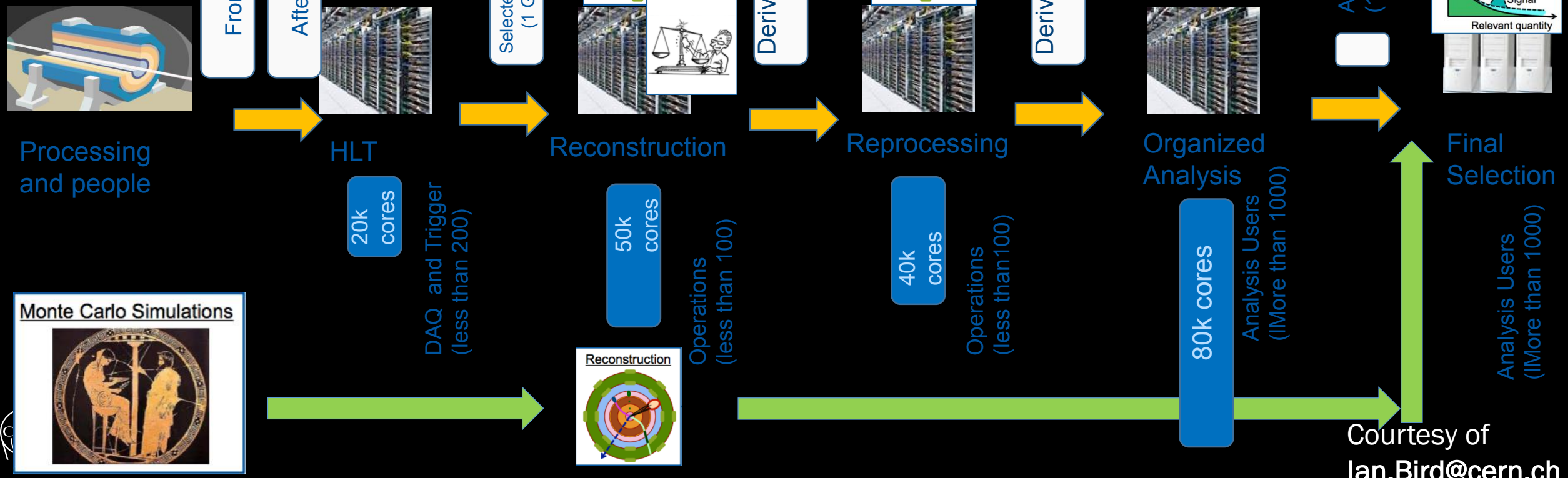




Data Analysis at the LHC

The process to transform raw data into useful physics datasets

- This is a complicated series of steps at the LHC (Run2)



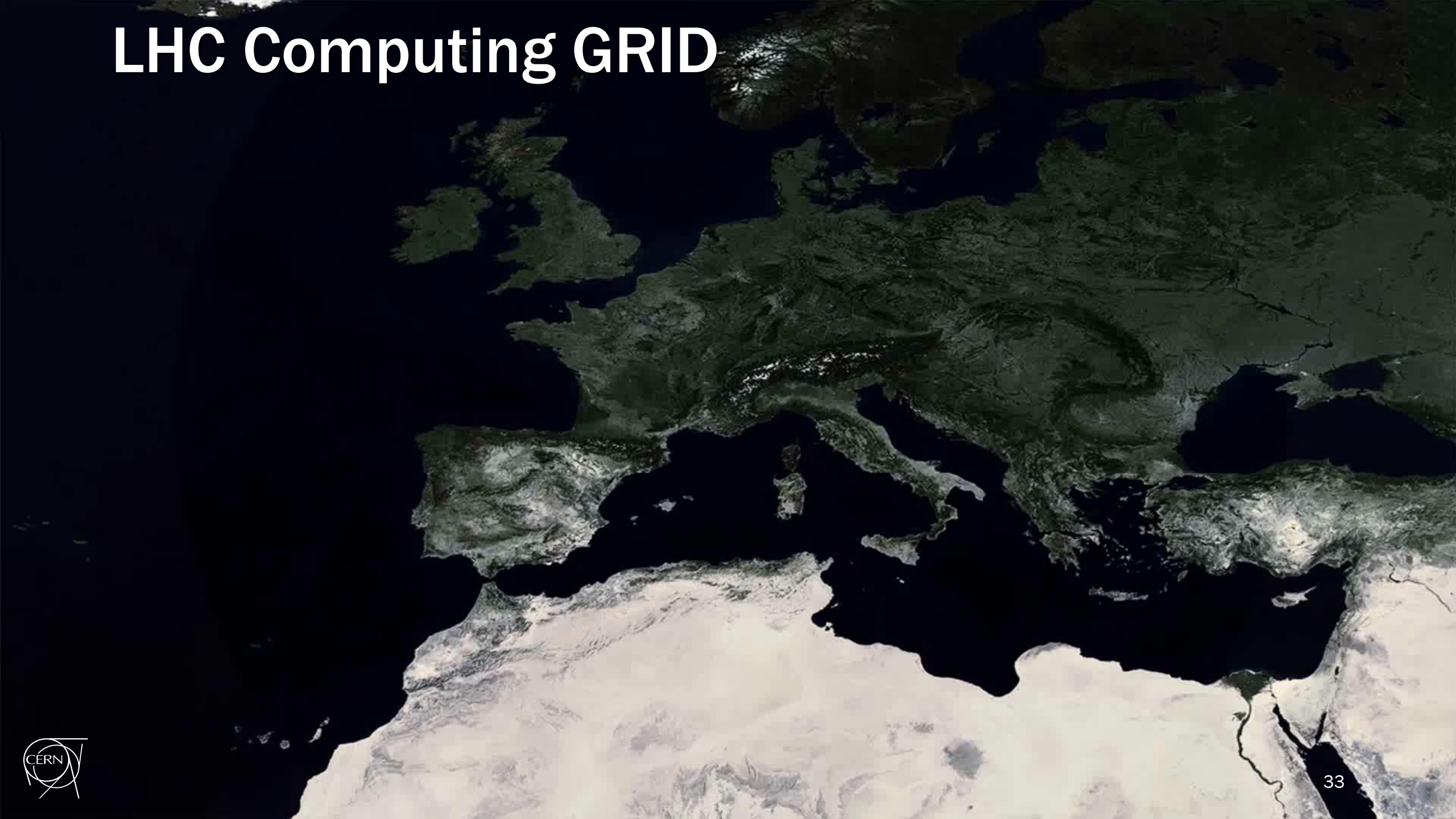
Courtesy of Ian.Bird@cern.ch

Computer Centre (Tier 0)

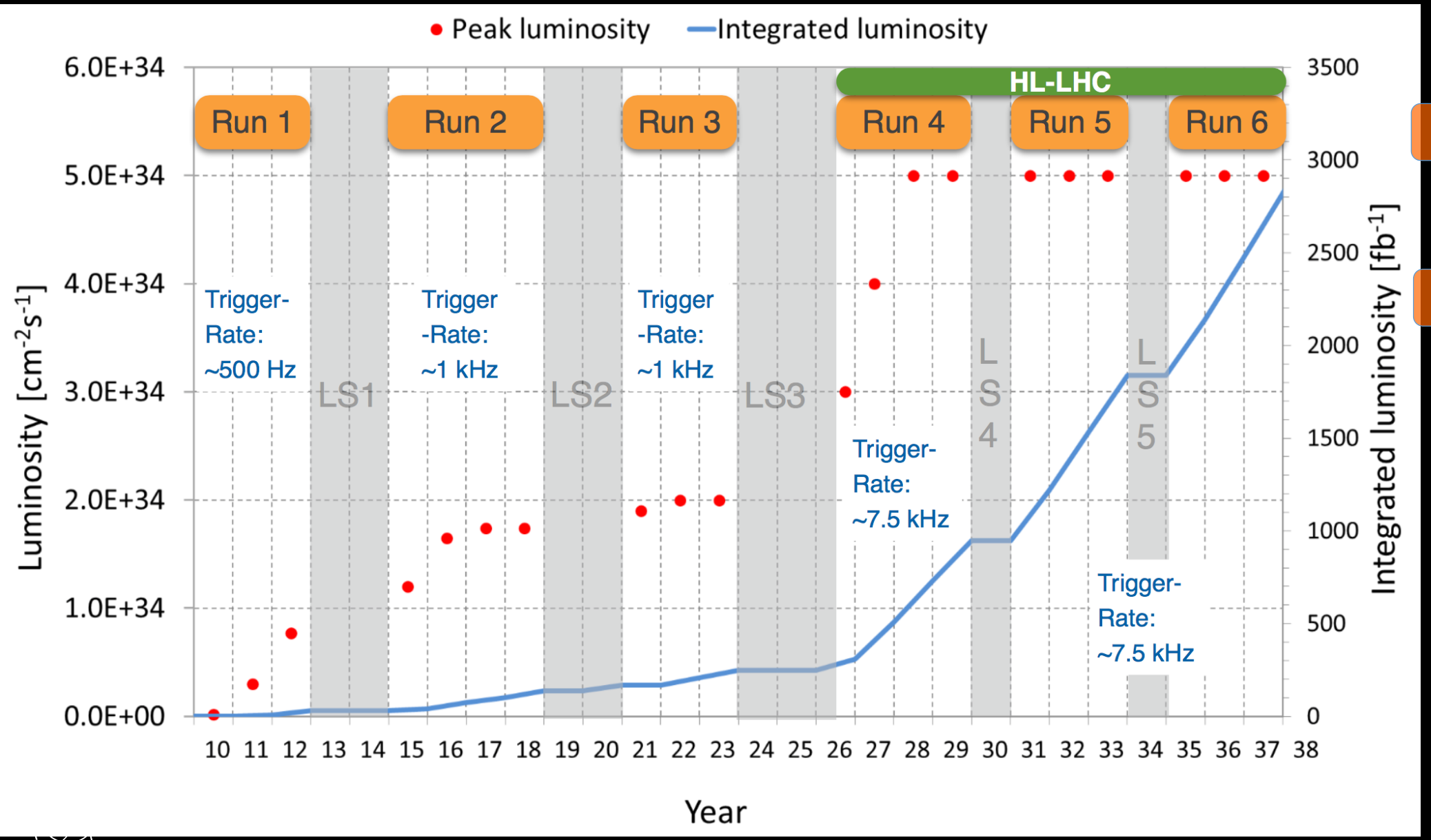
Raw recording rate ~10 ½ GByte/sec
175,000 processing cores
150 PetaBytes of data storage on disk

380 PetaBytes of data storage on tape
~50 PetaBytes/year

LHC Computing GRID



LHC Schedule



Run 3 — Alice, LHCb upgrades

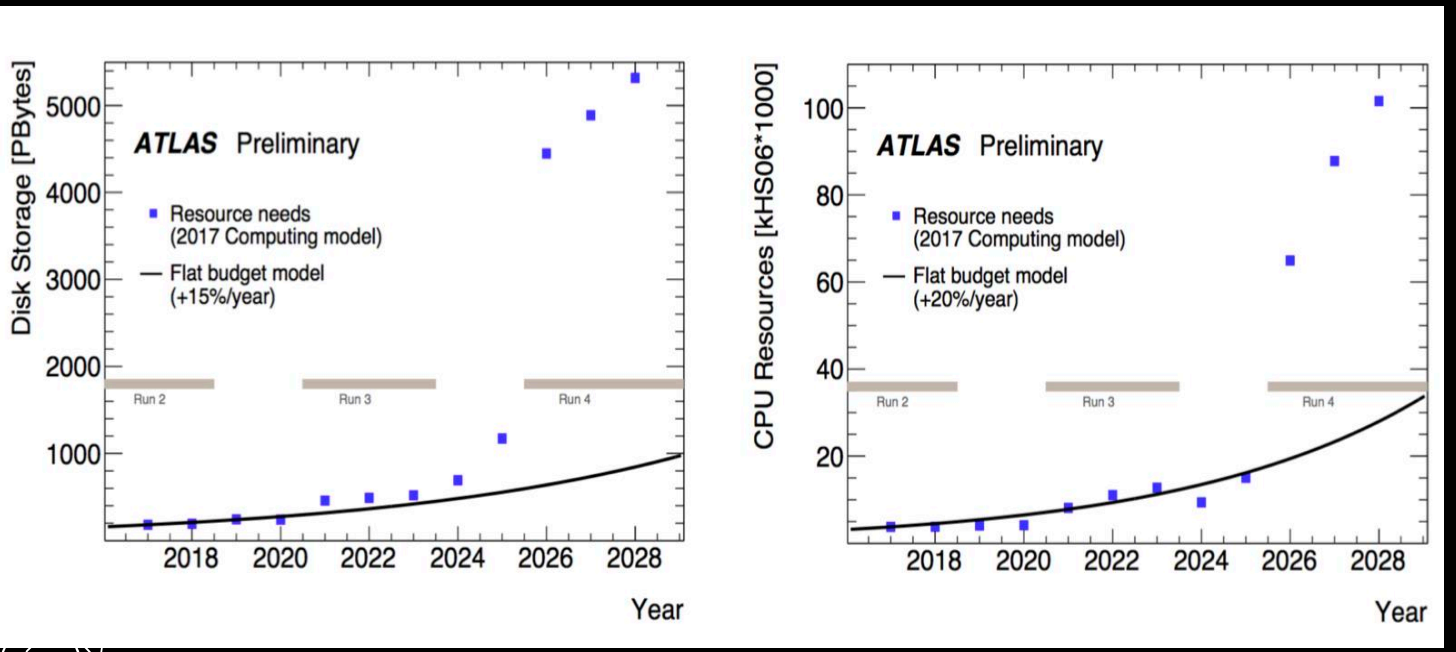
Run 4 — ATLAS, CMS upgrades

Courtesy of
Ian.Bird@cern.ch

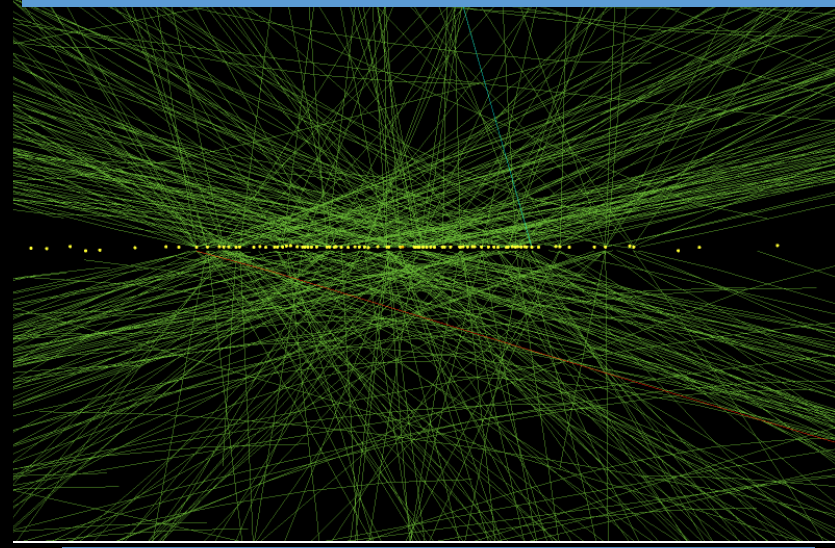
The HL-LHC computing challenge

- HL-LHC needs for ATLAS and CMS are above the expected hardware technology evolution (15% to 20%/yr) and funding (flat)

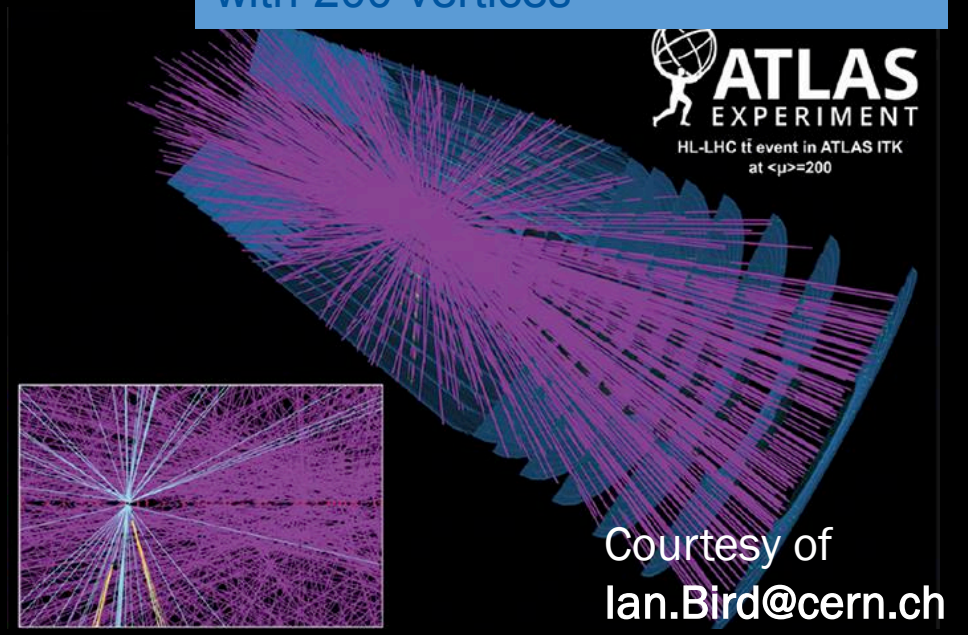
- The main challenge is storage, but computing requirements grow 20-50x



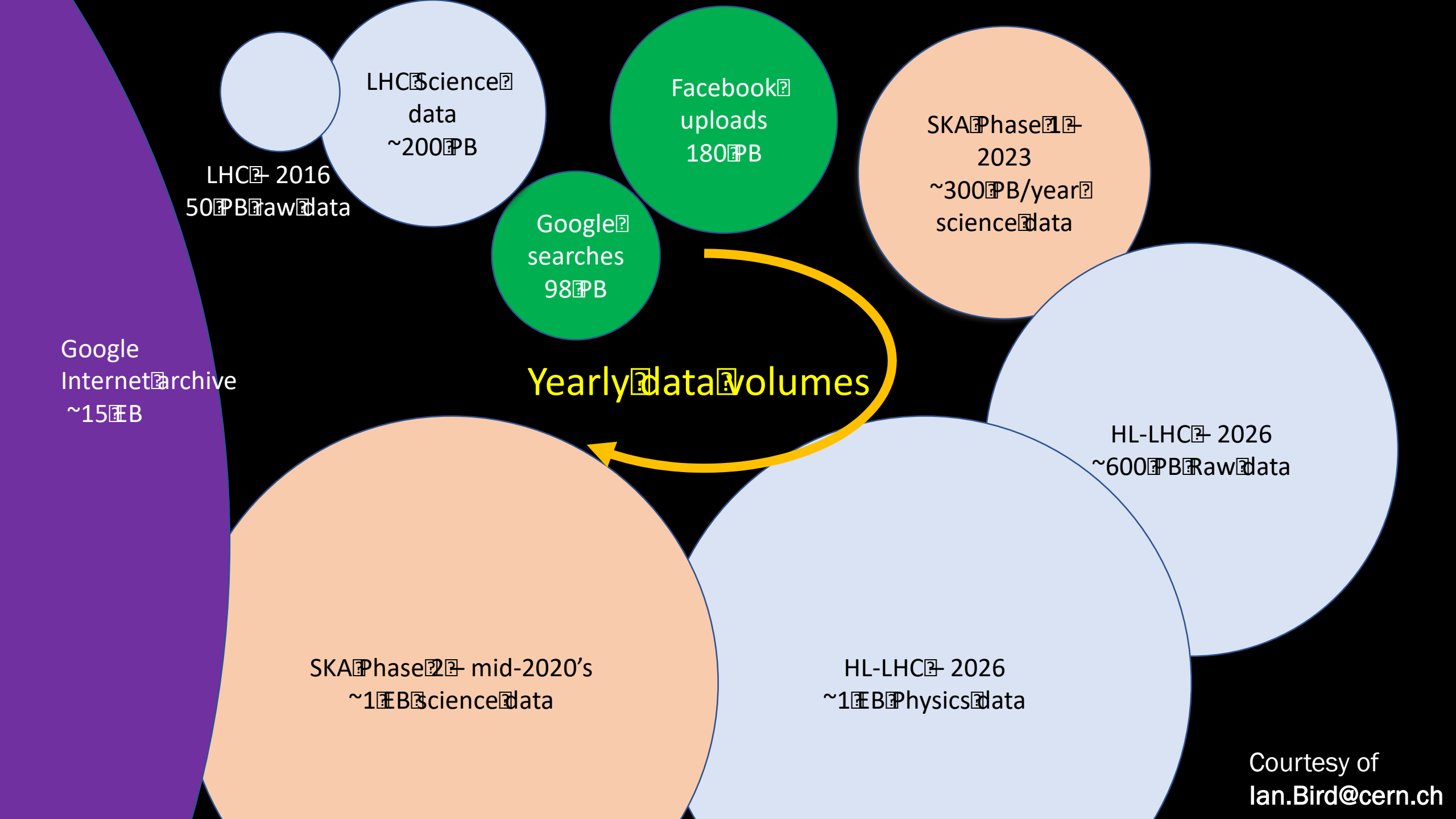
CMS: event from 2017 with 78 reconstructed vertices



ATLAS: simulation for HL-LHC with 200 vertices



Courtesy of
Ian.Bird@cern.ch


LHC - 2016
50 PB raw data
LHC Science data
~200 PB
Facebook uploads
180 PB
Google searches
98 PB
SKA Phase 1 - 2023
~300 PB/year science data
Google Internet archive
~15 EB
Yearly data volumes
HL-LHC - 2026
~600 PB Raw data
SKA Phase 2 - mid-2020's
~1 EB Science data
HL-LHC - 2026
~1 EB Physics data
Courtesy of
Ian.Bird@cern.ch

Open Source at CERN

- OpenStack
  - Private Cloud
- Ceph
  - Distributed object storage
- Grafana
  - Analytics and monitoring
- Puppet
  - Configuration management
- Kubernetes
  - Provisioning
- Indico (developed at CERN)
  - Event and room booking system (used by the UN, and many other institutes)



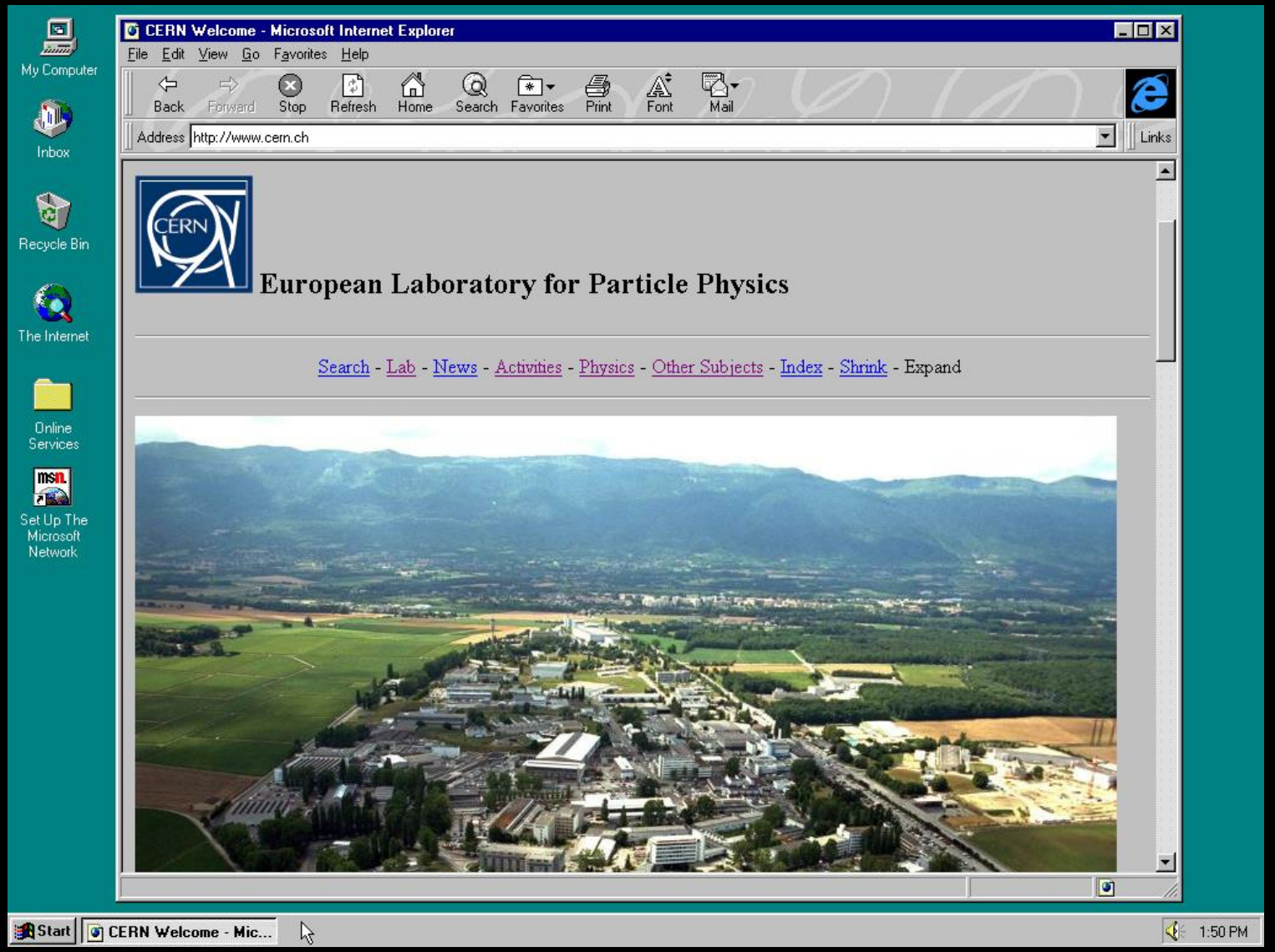
MAlt project (Microsoft Alternatives)

- Microsoft revoked CERN's academic status
  - Licensing costs increased by tenfold (not sustainable for CERN)
- We have been given a ramp-up profile over 10 years to adapt
- Multi year project started at CERN already (**MAlt**)
  - SharePoint -> Drupal, Discourse, etc.
  - Microsoft Active Directory Federation Services (ADFS / SSO) -> KeyCloak
  - Skype for Business -> WebRTC + Mattermost ("open-source Slack")
  - Etc.
- OEM licenses to be kept
- http://cern.ch/malt

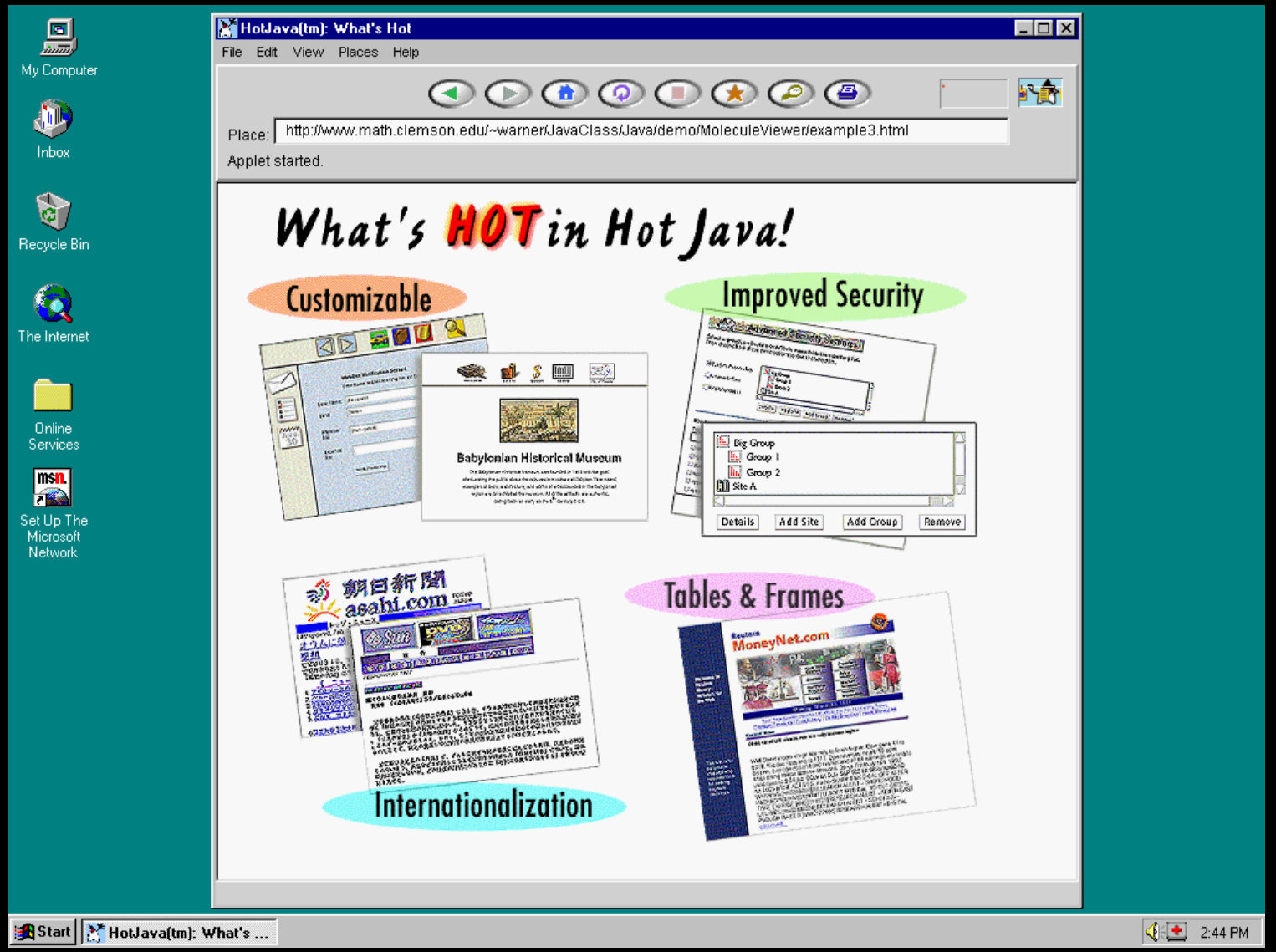
Accelerator Controls and the role of Java



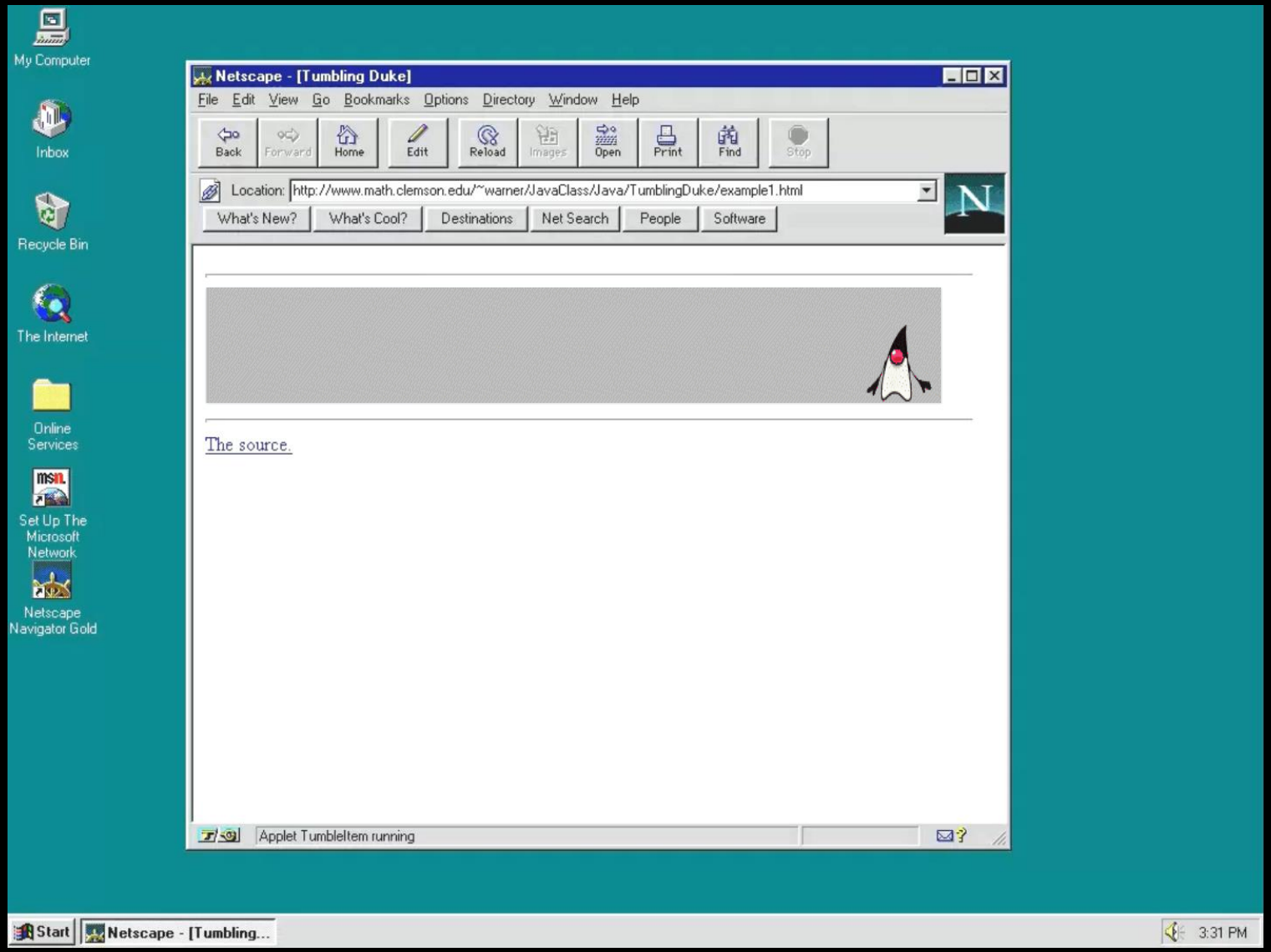
The Web: Windows 95



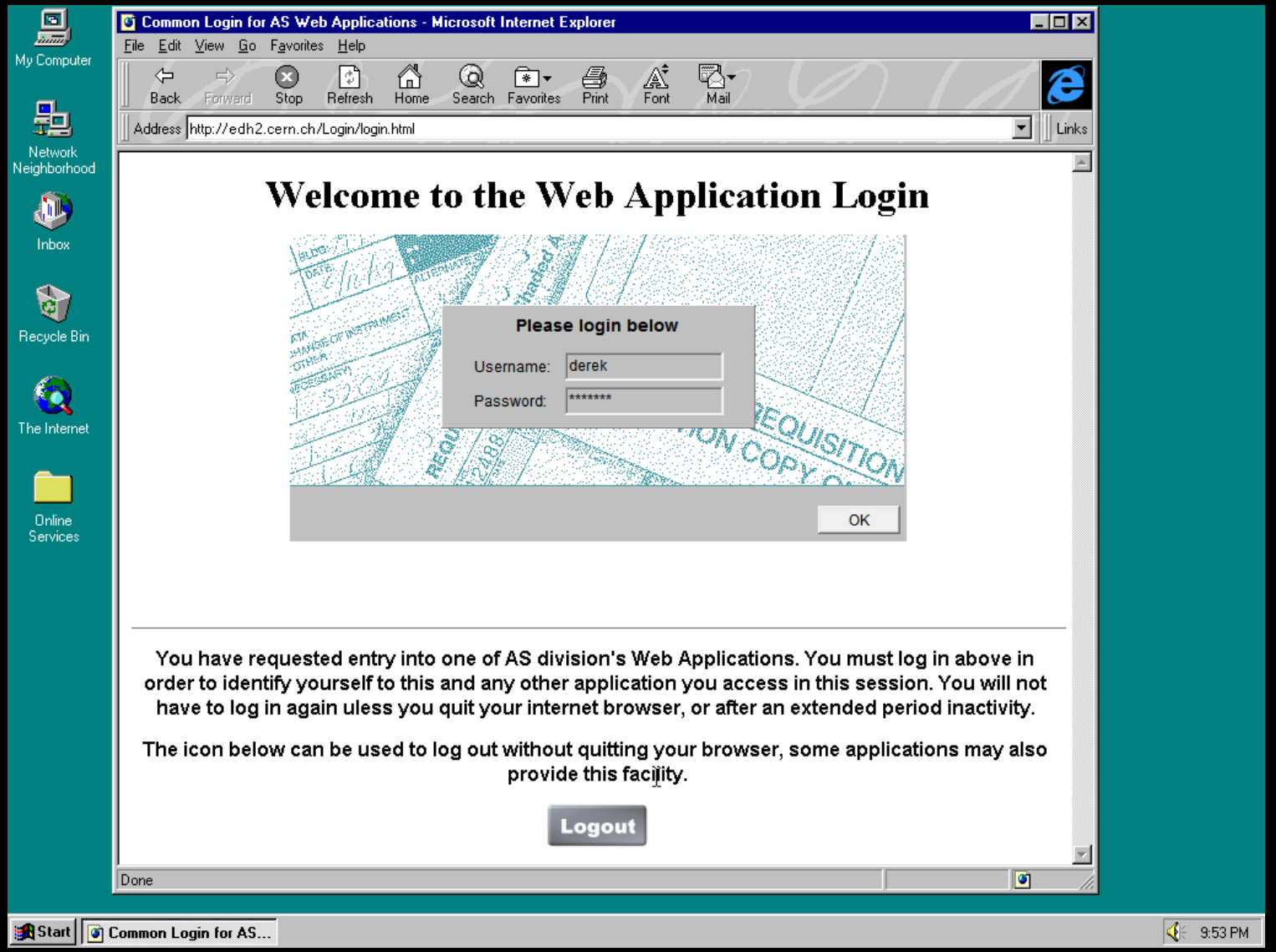
The Web: Windows 95



The Web: Windows 95



Java begins...

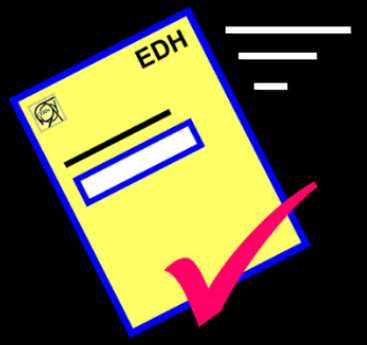

Common Login for AS Web Applications - Microsoft Internet Explorer
File Edit View Go Favorites Help
Back Forward Stop Refresh Home Search Favorites Print Font Mail
Address http://edh2.cern.ch/Login/login.html
Links
Welcome to the Web Application Login
Please login below
Username: derek
Password: *******
OK
You have requested entry into one of AS division's Web Applications. You must log in above in order to identify yourself to this and any other application you access in this session. You will not have to log in again uless you quit your internet browser, or after an extended period inactivity.
The icon below can be used to log out without quitting your browser, some applications may also provide this facility.
Logout
Done
My Computer
Network Neighborhood
Inbox
Recycle Bin
The Internet
Online Services
Start
Common Login for AS...
9:53 PM

IDE's....


Version 1.0
©1996 Symantec Corporation.
Requires Windows 95 or later, or Windows NT 4.0 or later
Microsoft
Member of Microsoft Visual Studio
Development System for Java
The ease of Java, the power of Windows
Microsoft Visual J++ 6.0
Professional Edition
ualCafé 4
RT EDITION
EC. © 1999 Symantec Corporation. All rights reserved.
Oracle JDeveloper 10g
Release 3 (10.1.3) Early Access
Productivity with Choice
ORACLE
IJ
IntelliJ IDEA
ULTIMATE 2017.2
Licensed to CERN / Derek Mathieson
Subscription is active until November 29, 2017
JET BRAINS

Administration

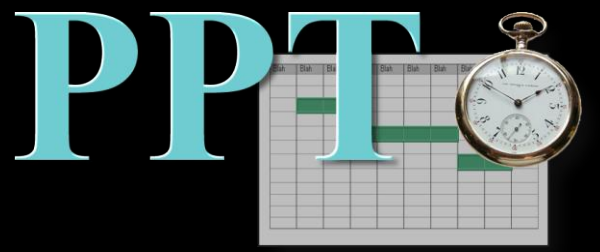
- Business Processes
  - Electronic Document Handling



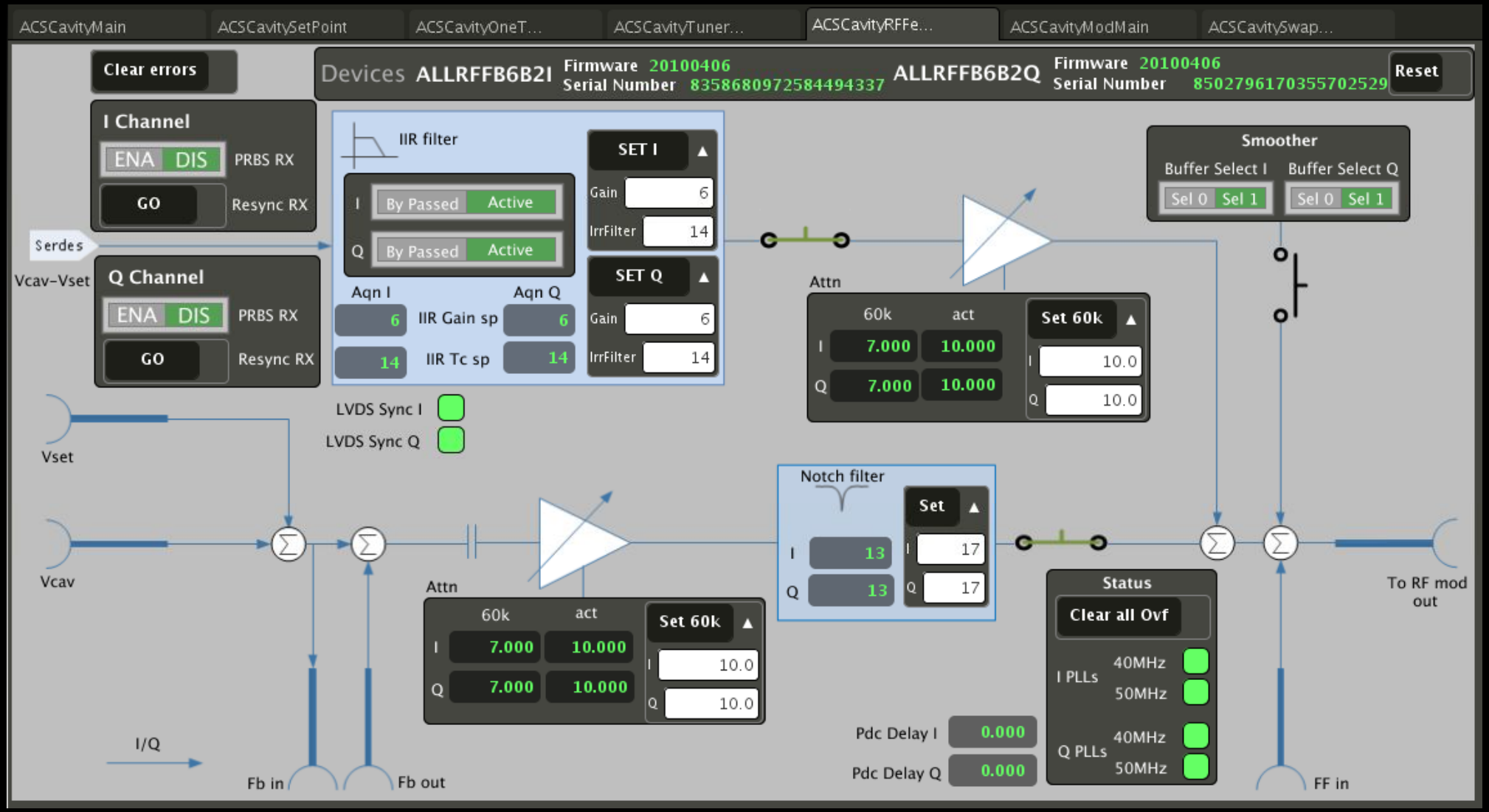
- Decision Support
  - CERN Expenditure Tracking
  - Human Resources Toolkit



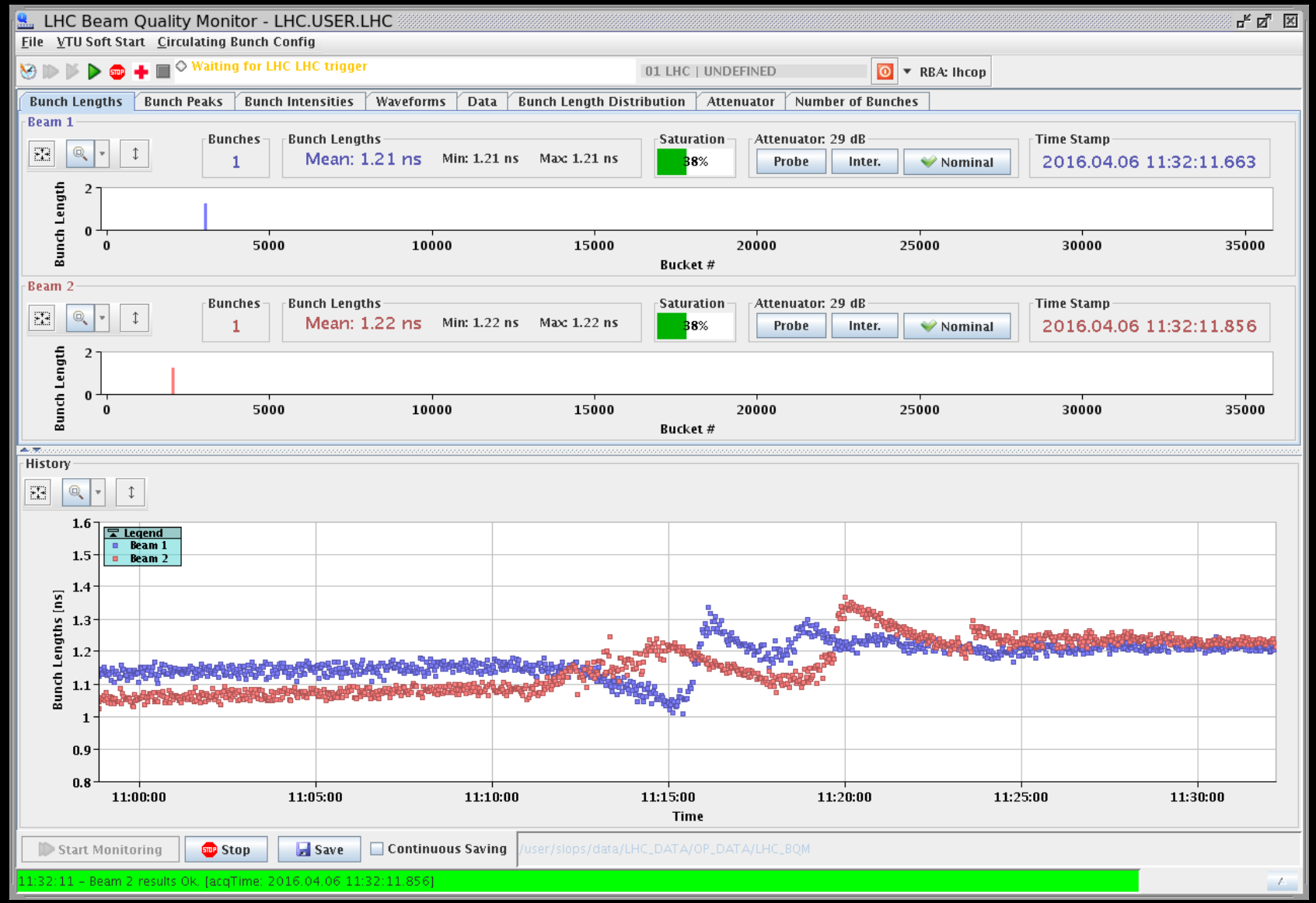
- Project Management Tools
  - Project Progress Tracking



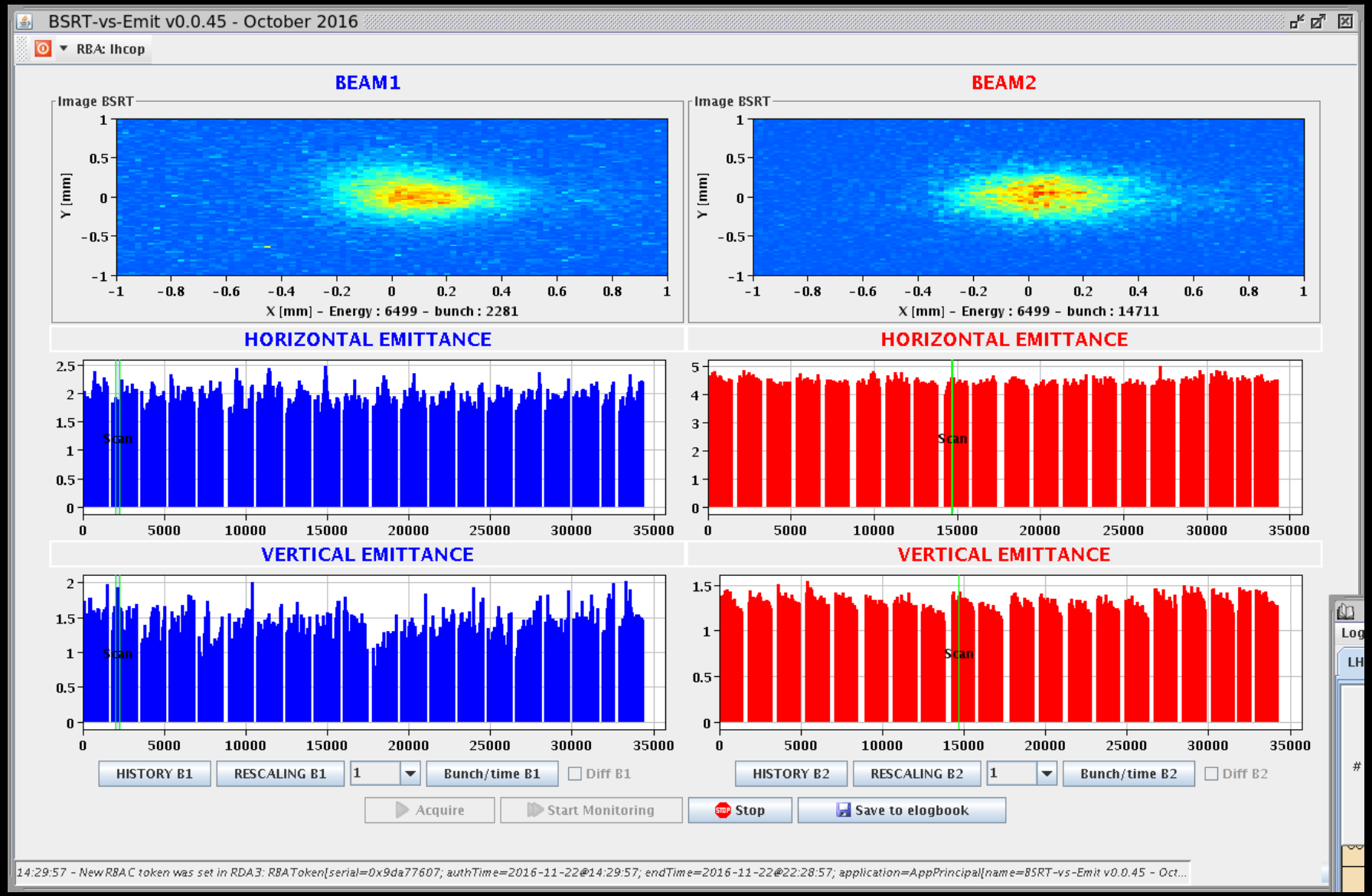
Accelerator Controls



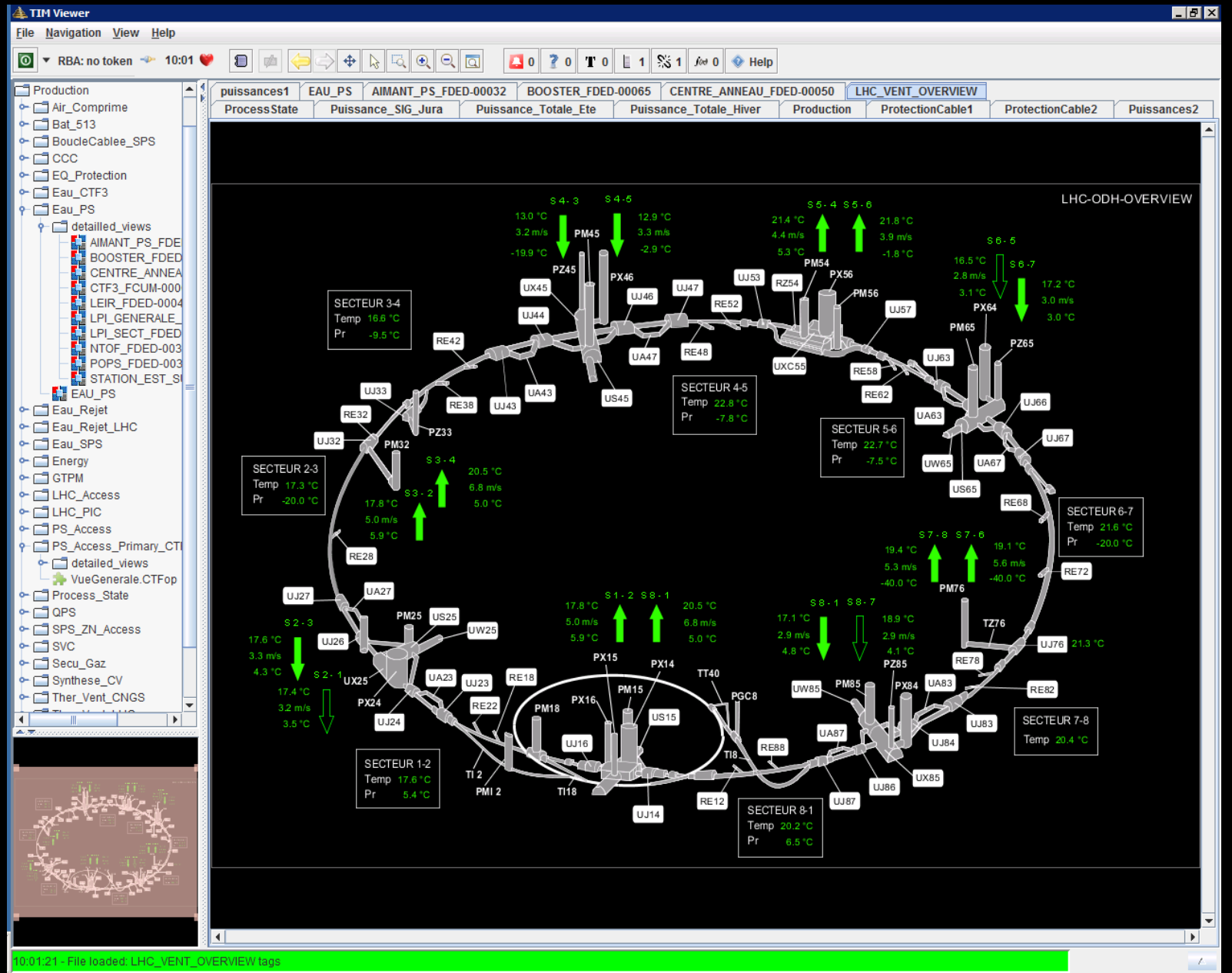
Accelerator Controls



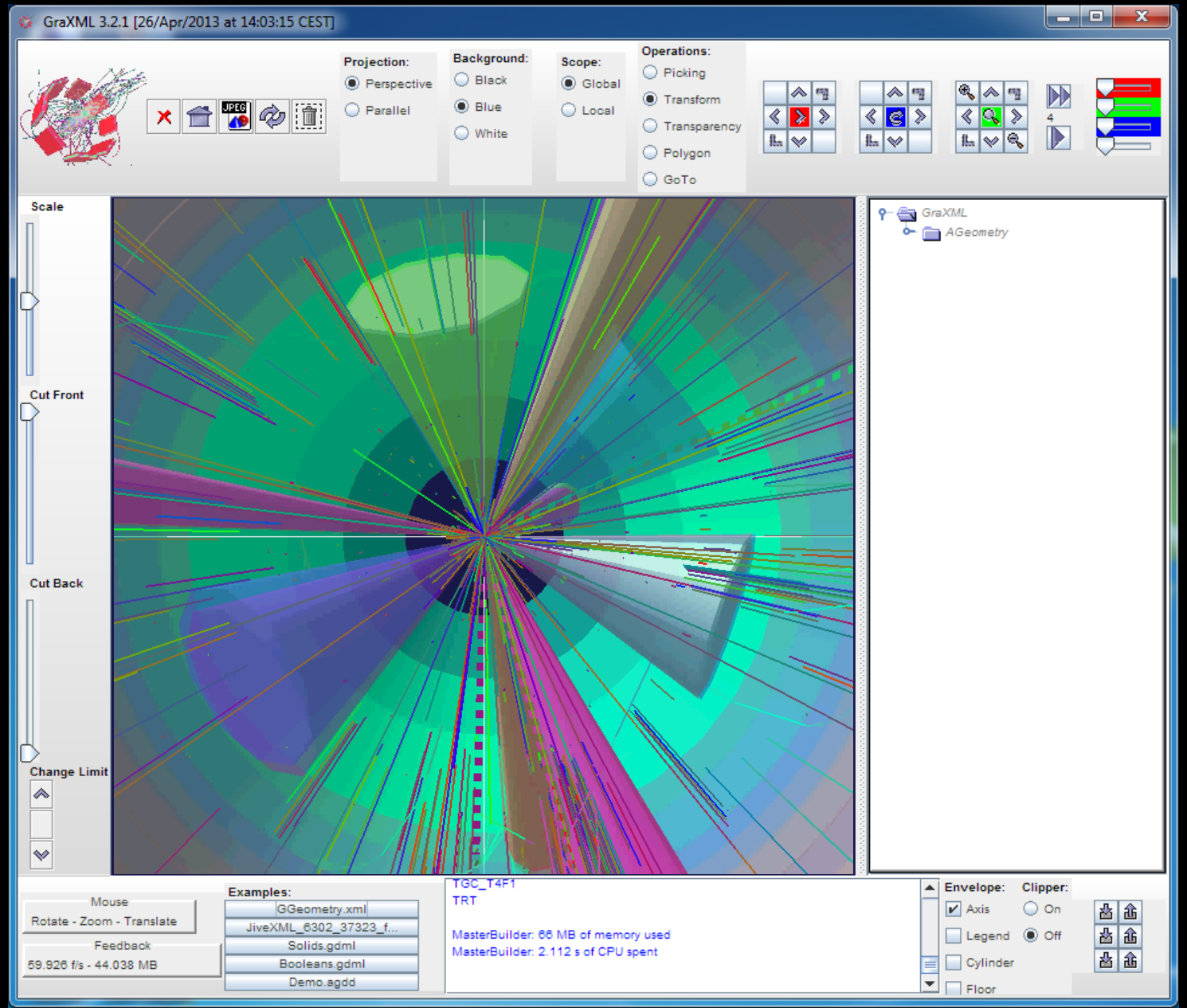
Accelerator Controls



Java Today: Monitoring



3D Visualization

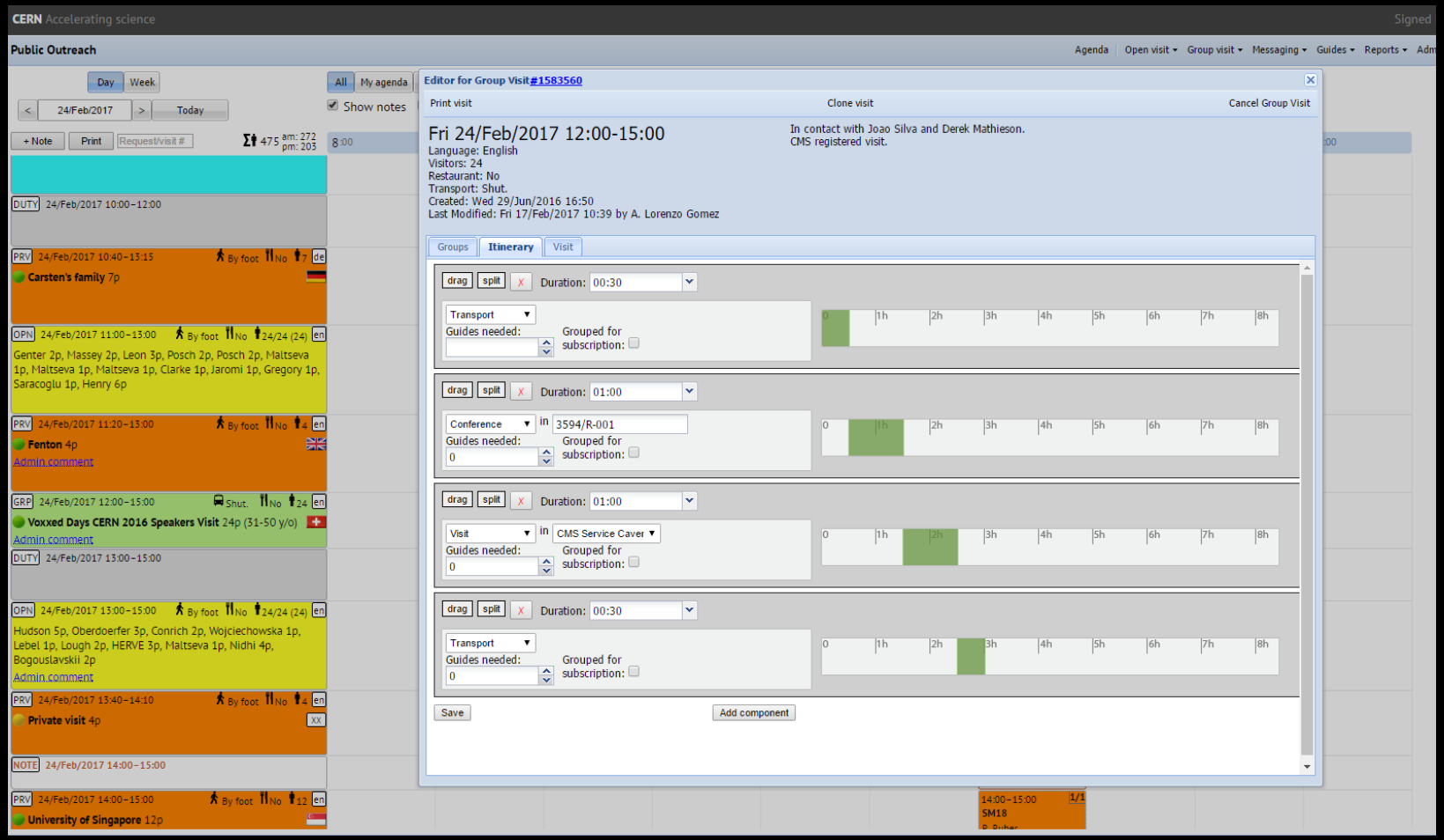


GRID Monitoring

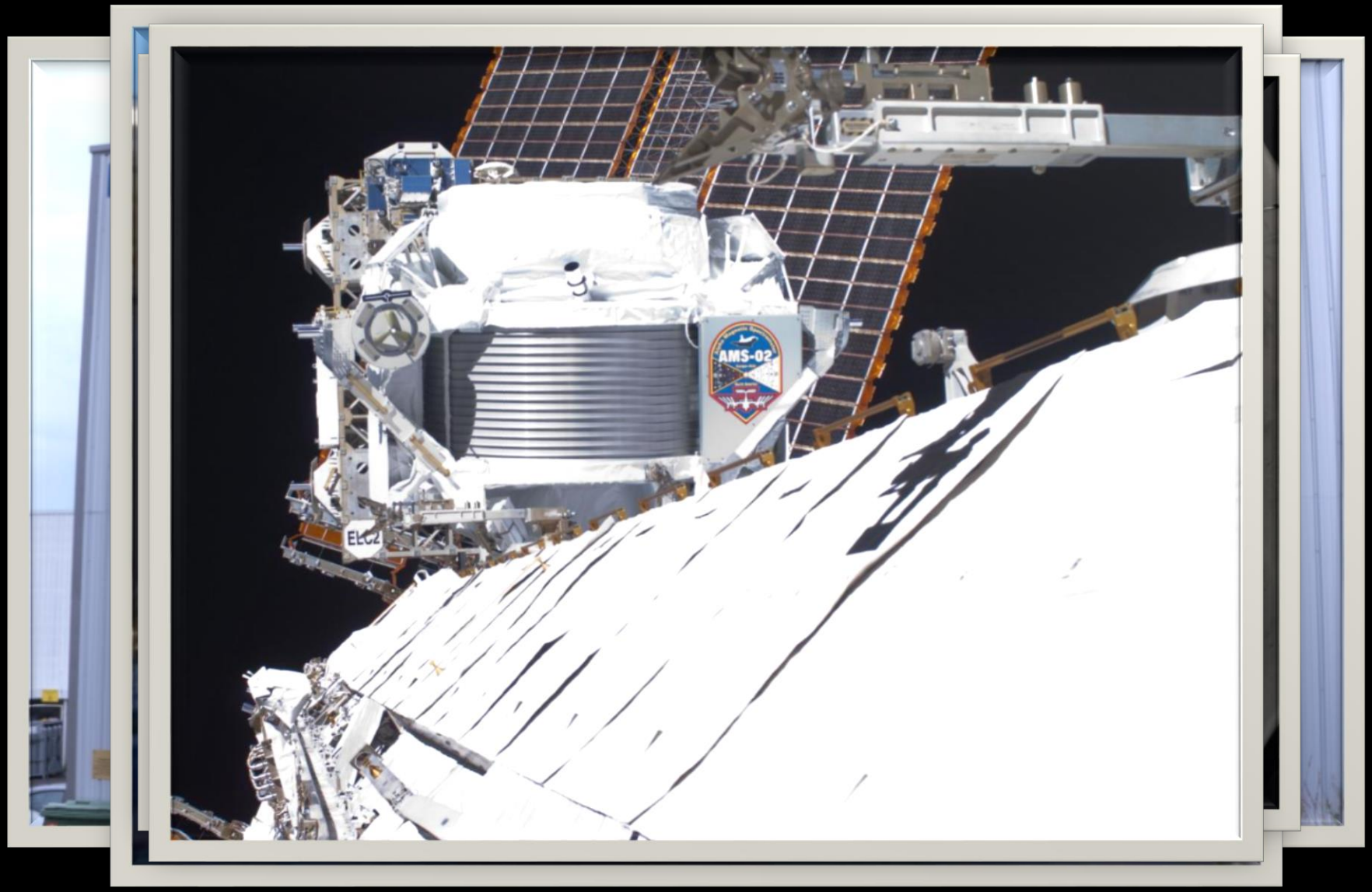


Java Today: Outreach

- 150’000 visitors from >90 countries
- More than 4’500 visiting groups per year



There’s more...



CERN: A Unique Place







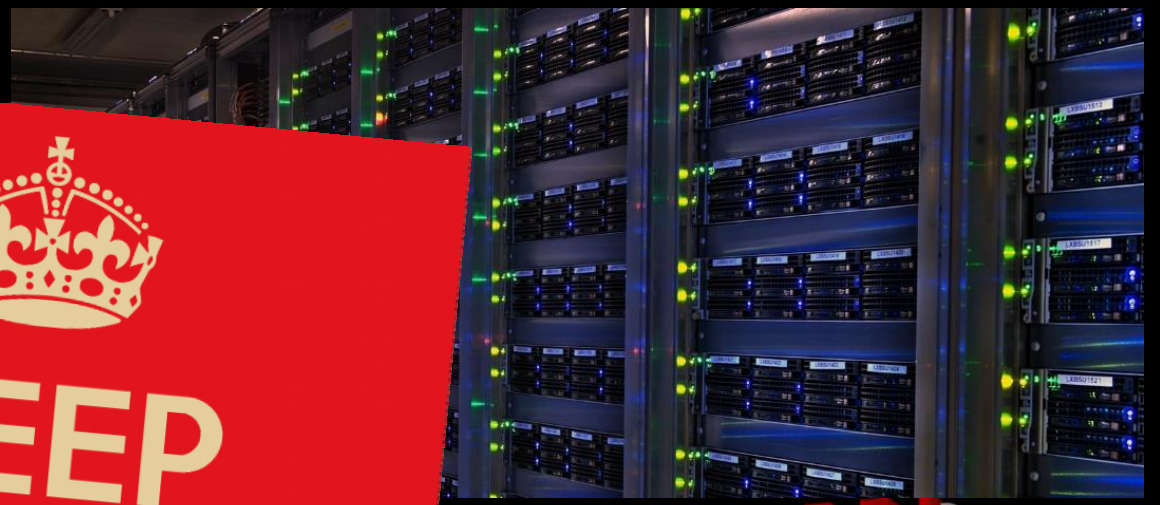


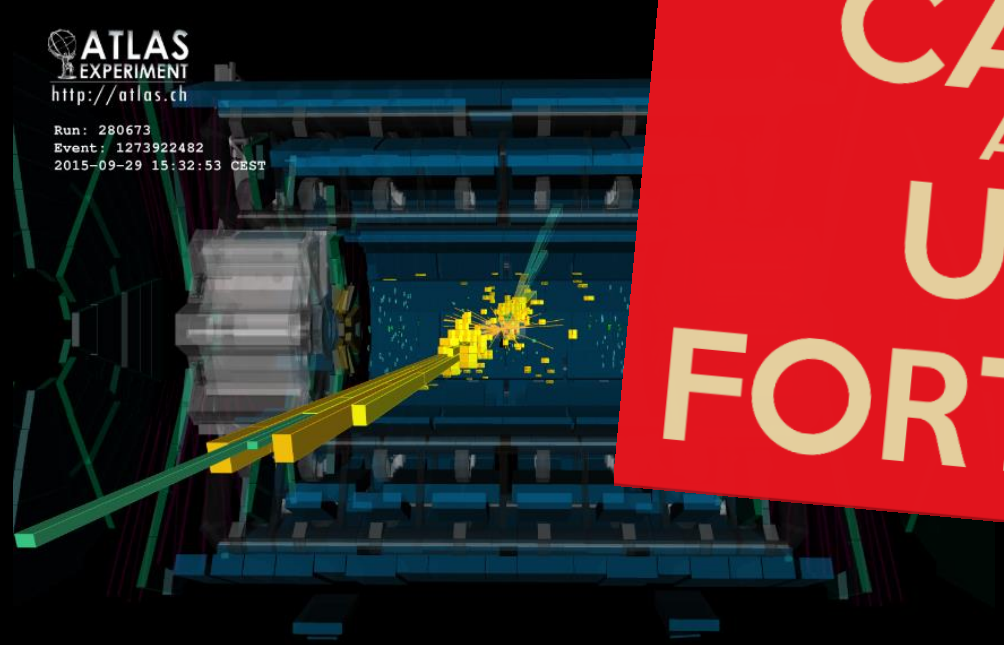
CERN: A Place of Contrasts



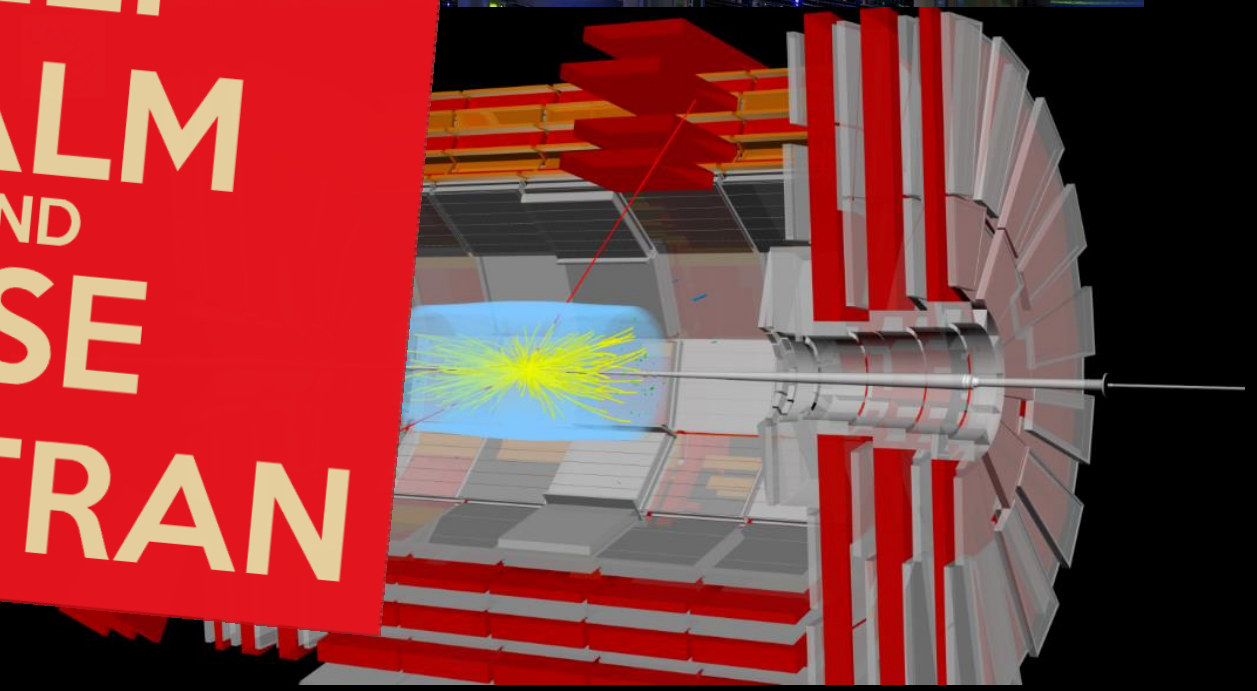
CERN: Computing Heart











CERN: An Open Lab





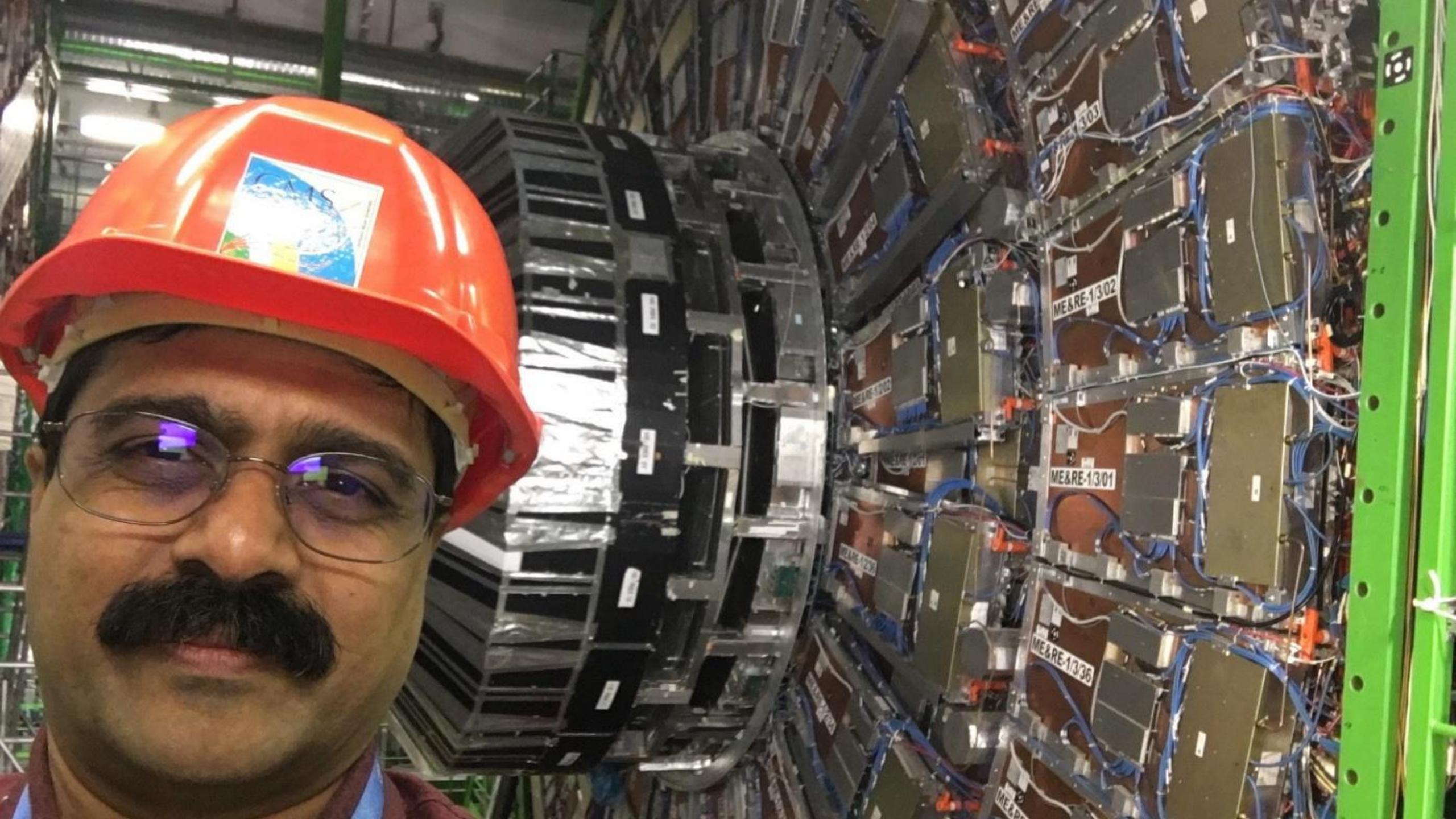
CERN OPENDAYS

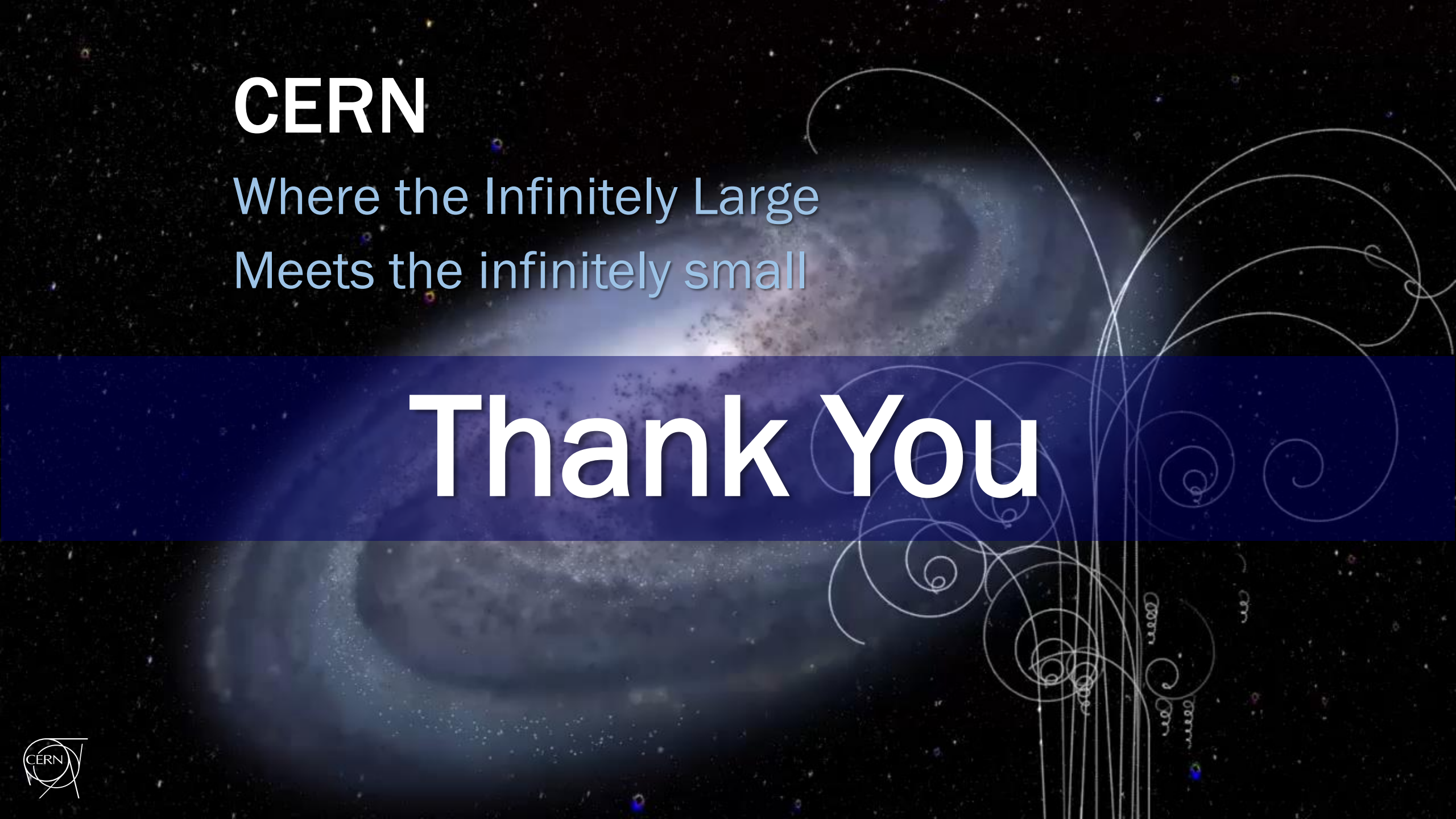
https://opendays.cern

- Explore the future with us
- Explorez le futur avec nous

14 - 15 septembre / September 2019

* Admission is **free of charge** for all audiences.
** Some sites may have age and access restrictions.


ME&RE-1/3/02
ME&RE-1/3/01
ME&RE-1/3/36


CERN
Where the Infinitely Large
Meets the infinitely small
Thank You
CERN