Worldwide LHC Computing Grid

Distributed Production Environment for Physics data Processing

WLCG

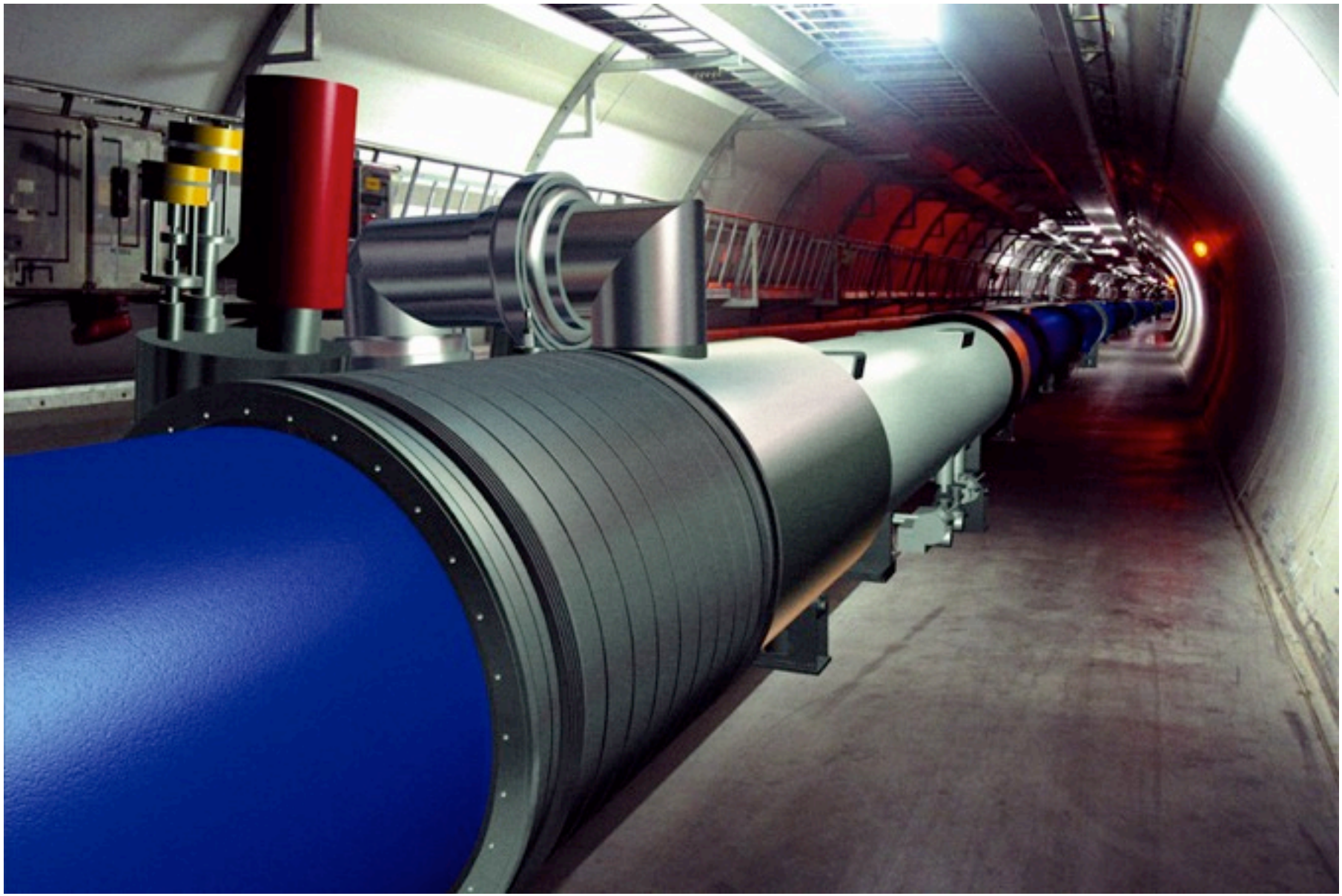
Computing resources for handling LHC data and using them.

Louis Poncet IT/GD

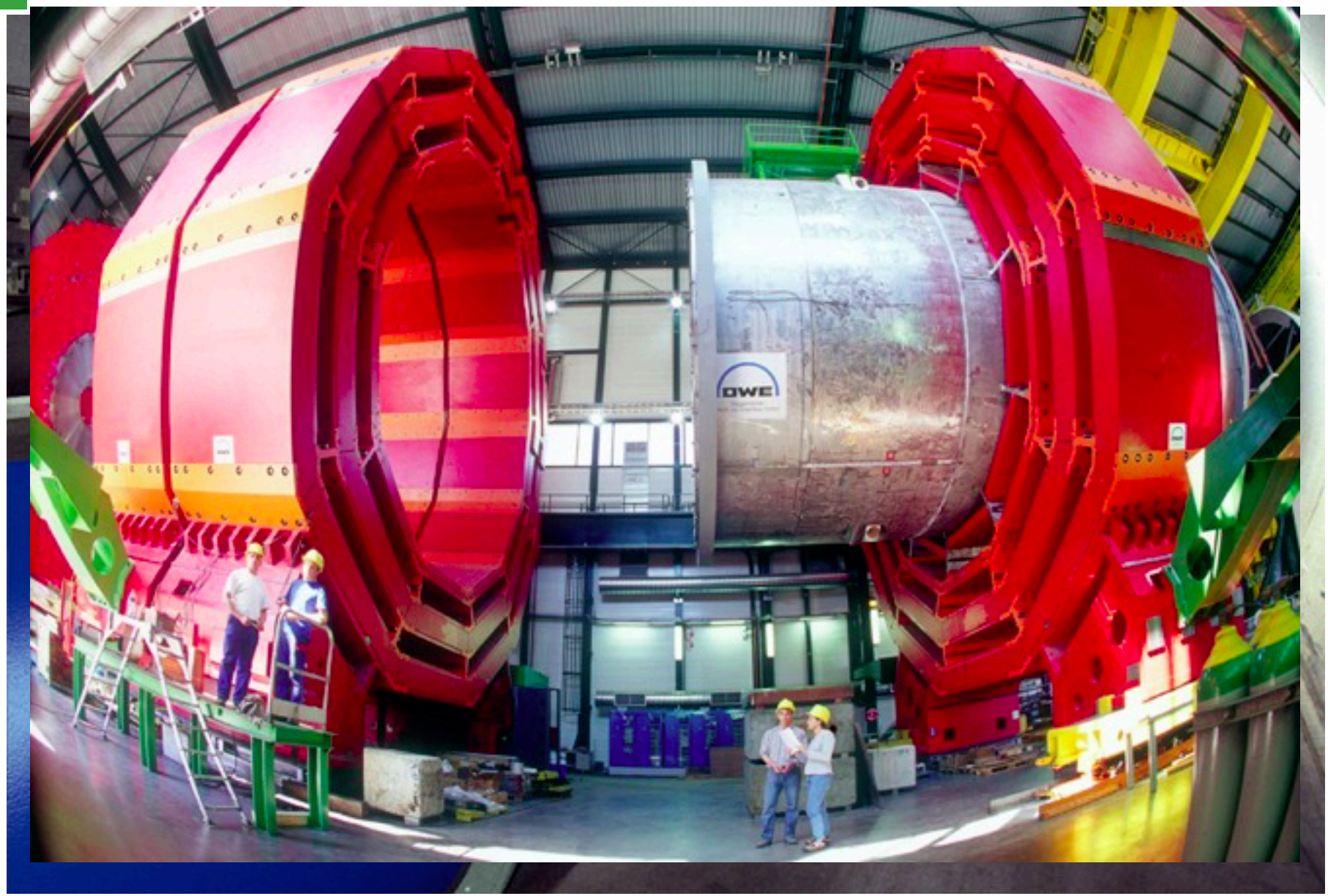
Summary

- The detectors
- LHC Computing
- What is a GRID ?
- But why a GRID for LHC ?
- LCG : Large Hydron Colider Computing Grid
- Dataflow
- WLCG software
- WLCG context
- Achievements
- Problems
- Questions
- Links

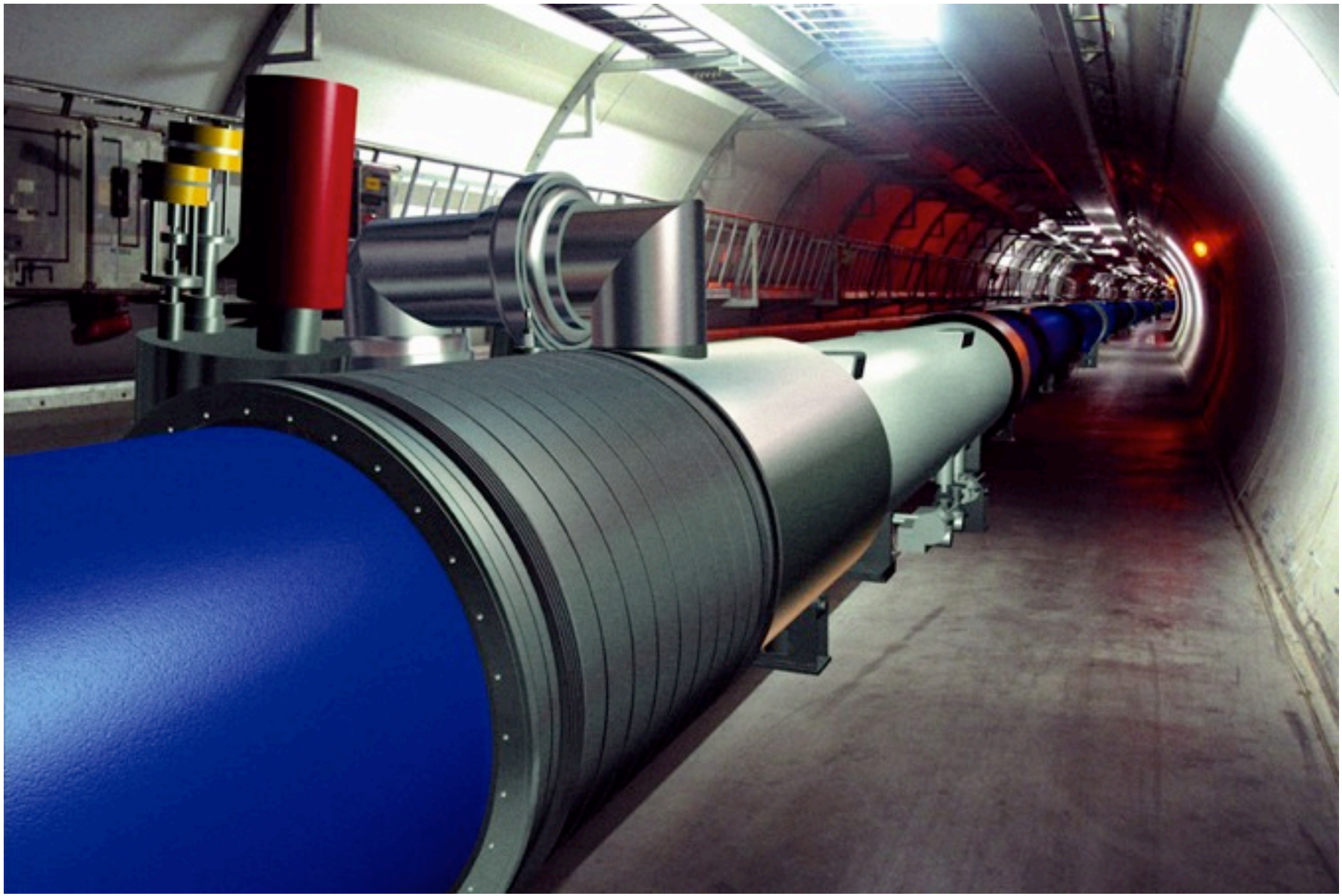
The detectors



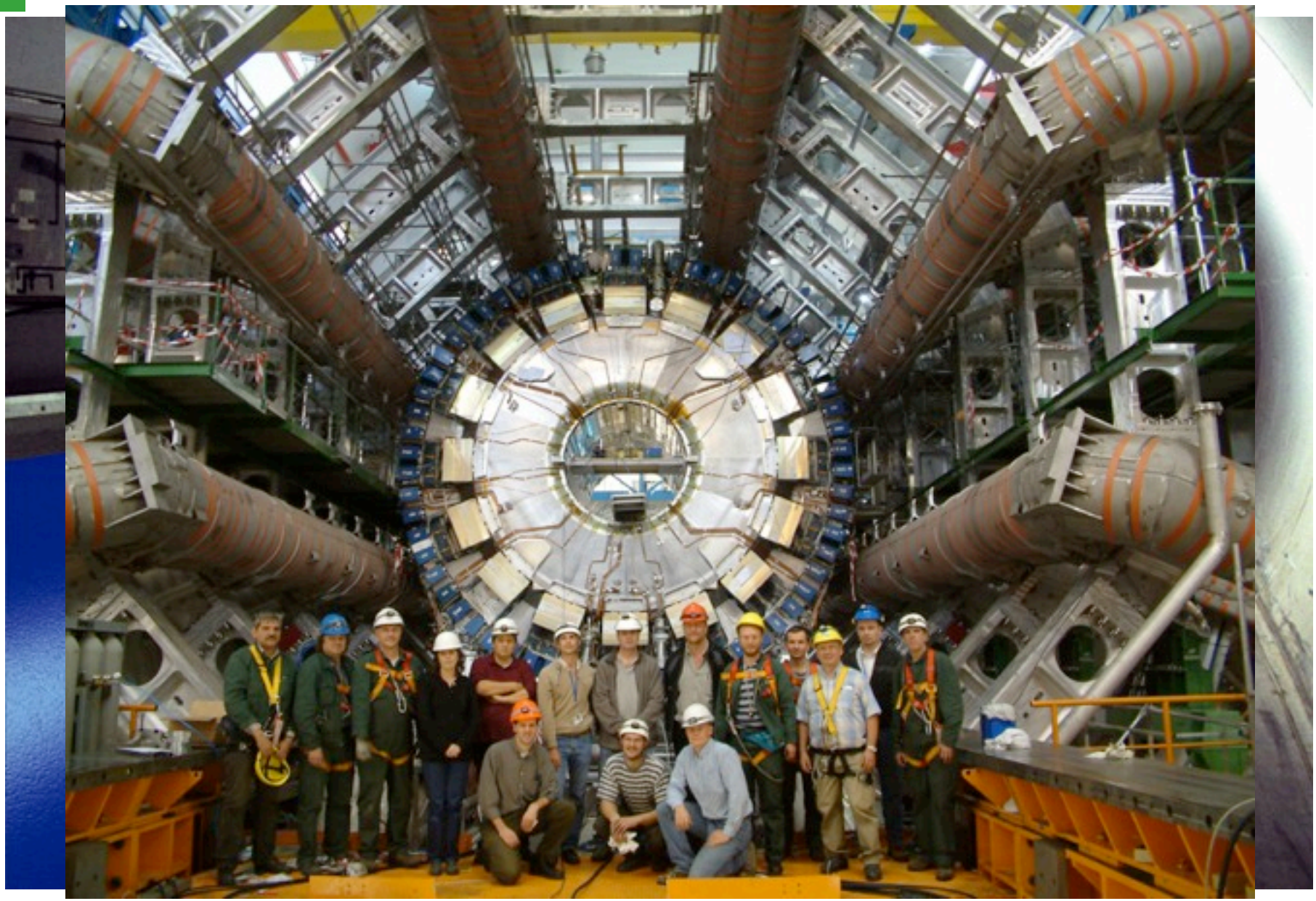
The detectors



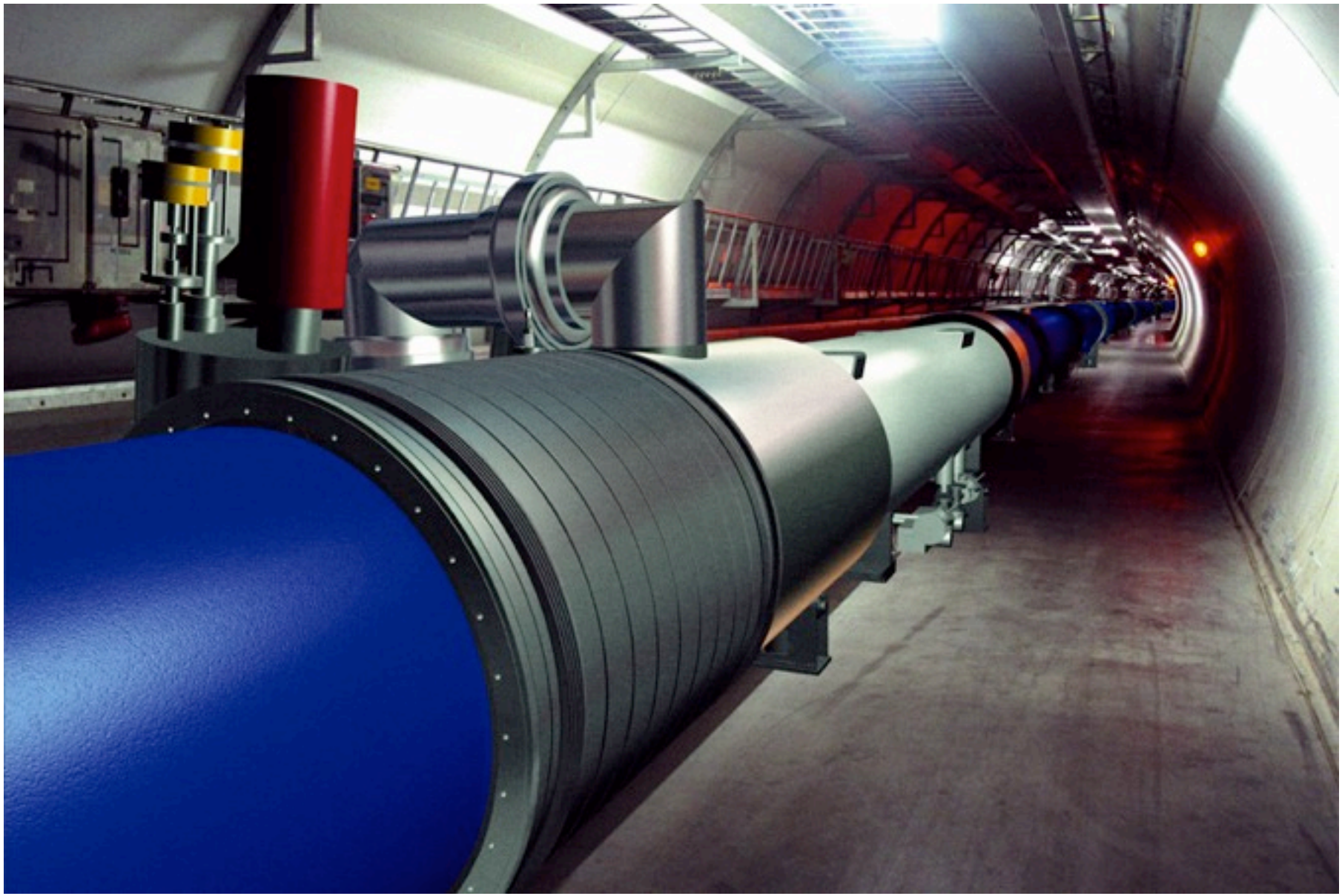
The detectors



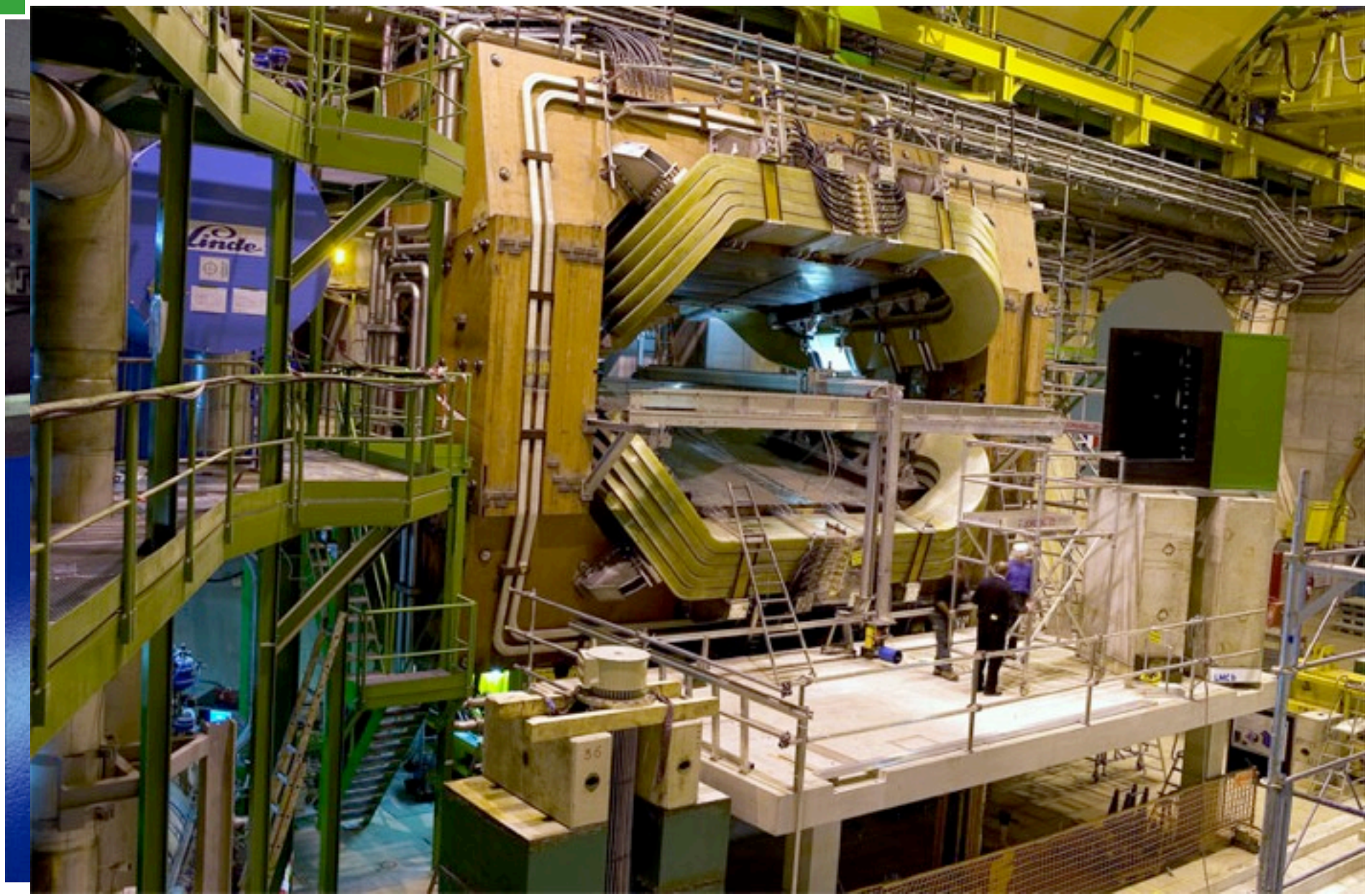
The detectors



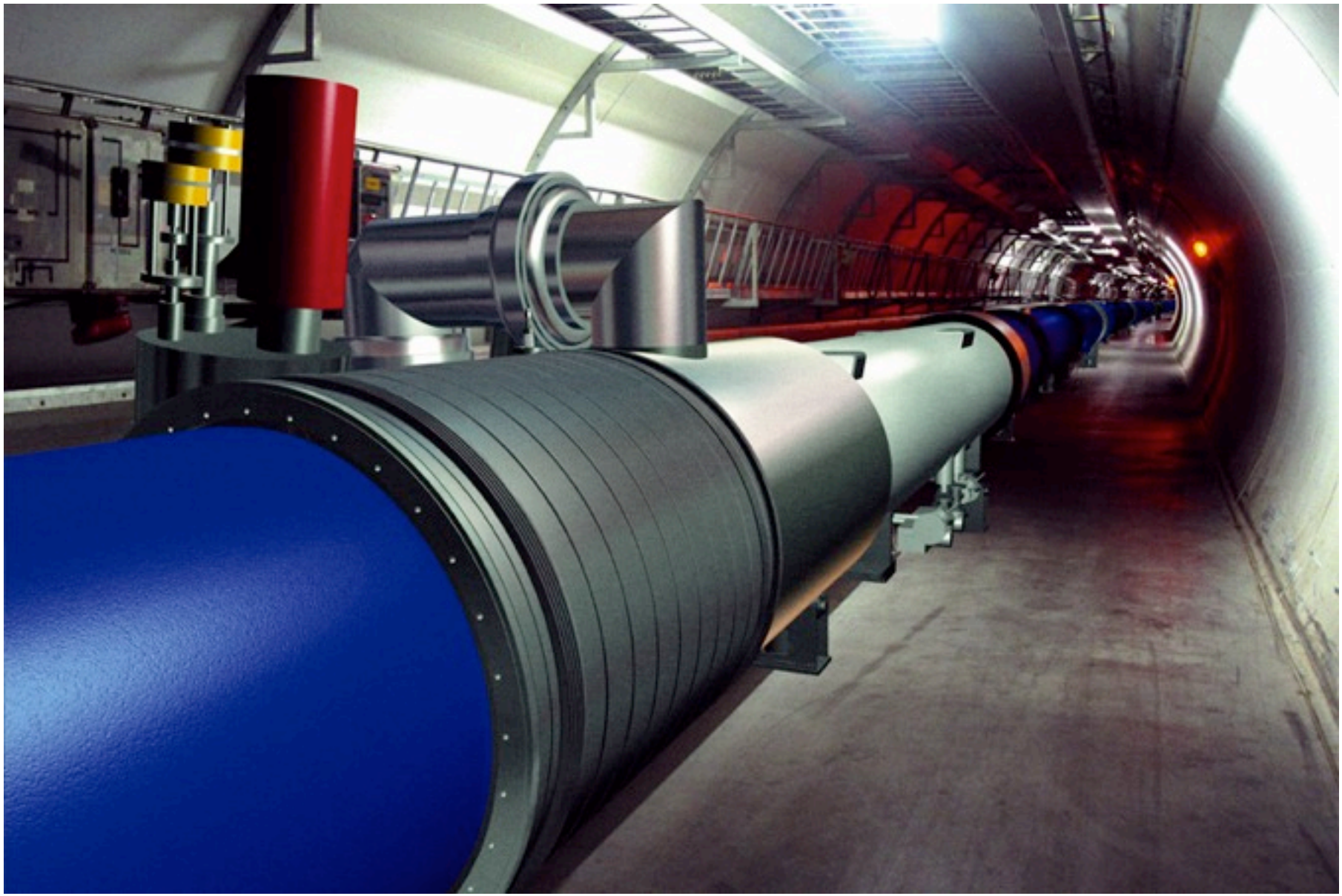
The detectors



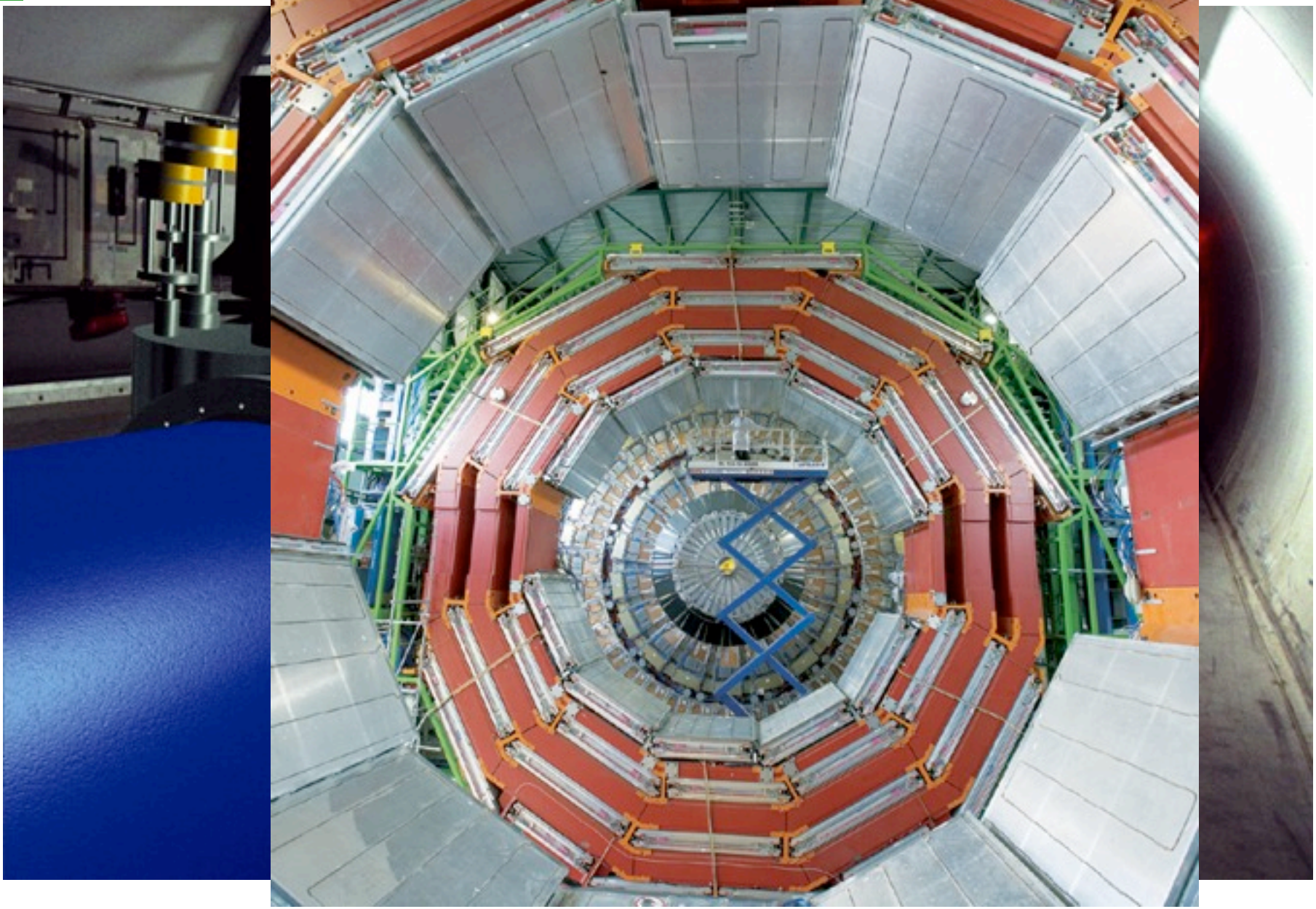
The detectors



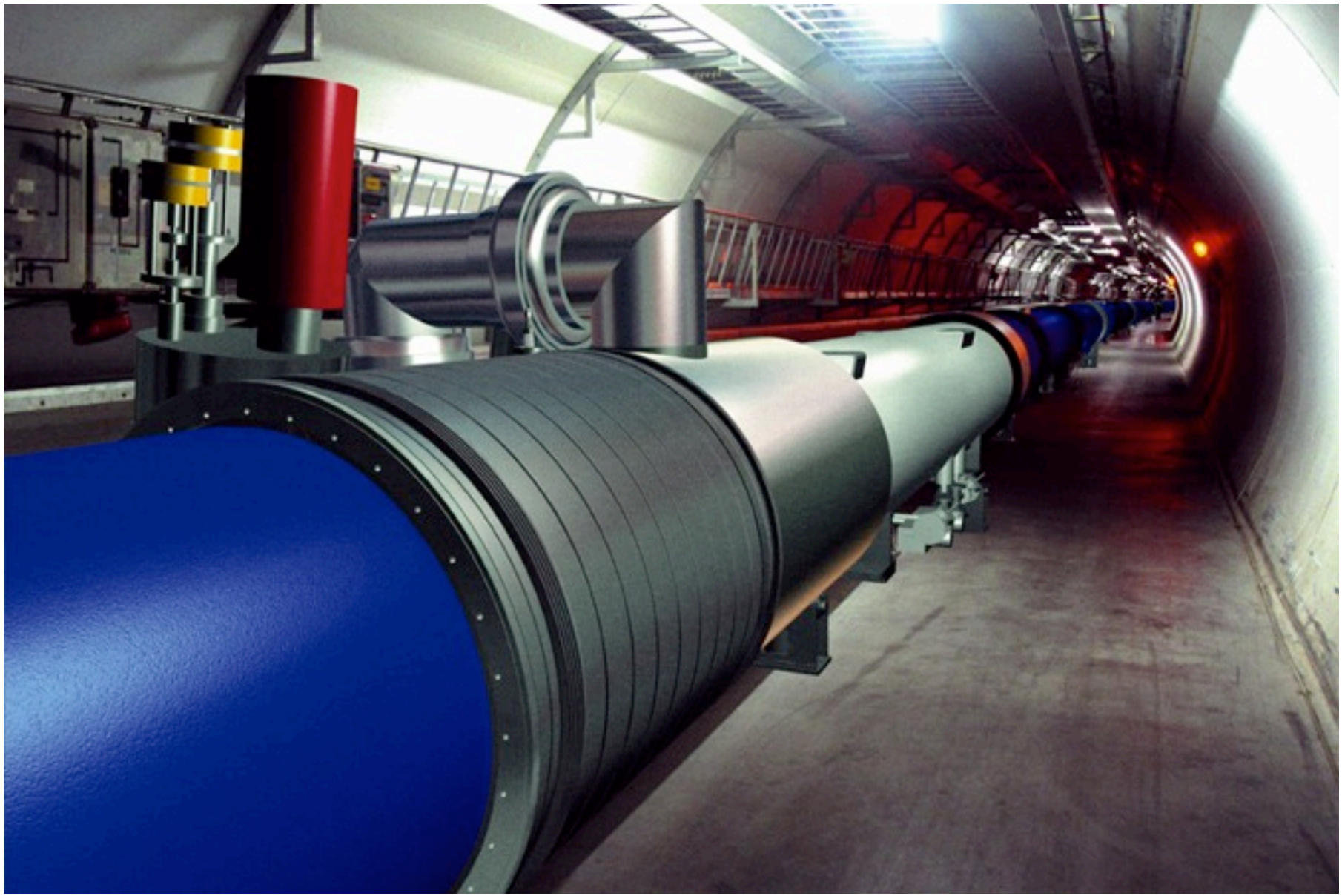
The detectors



The detectors



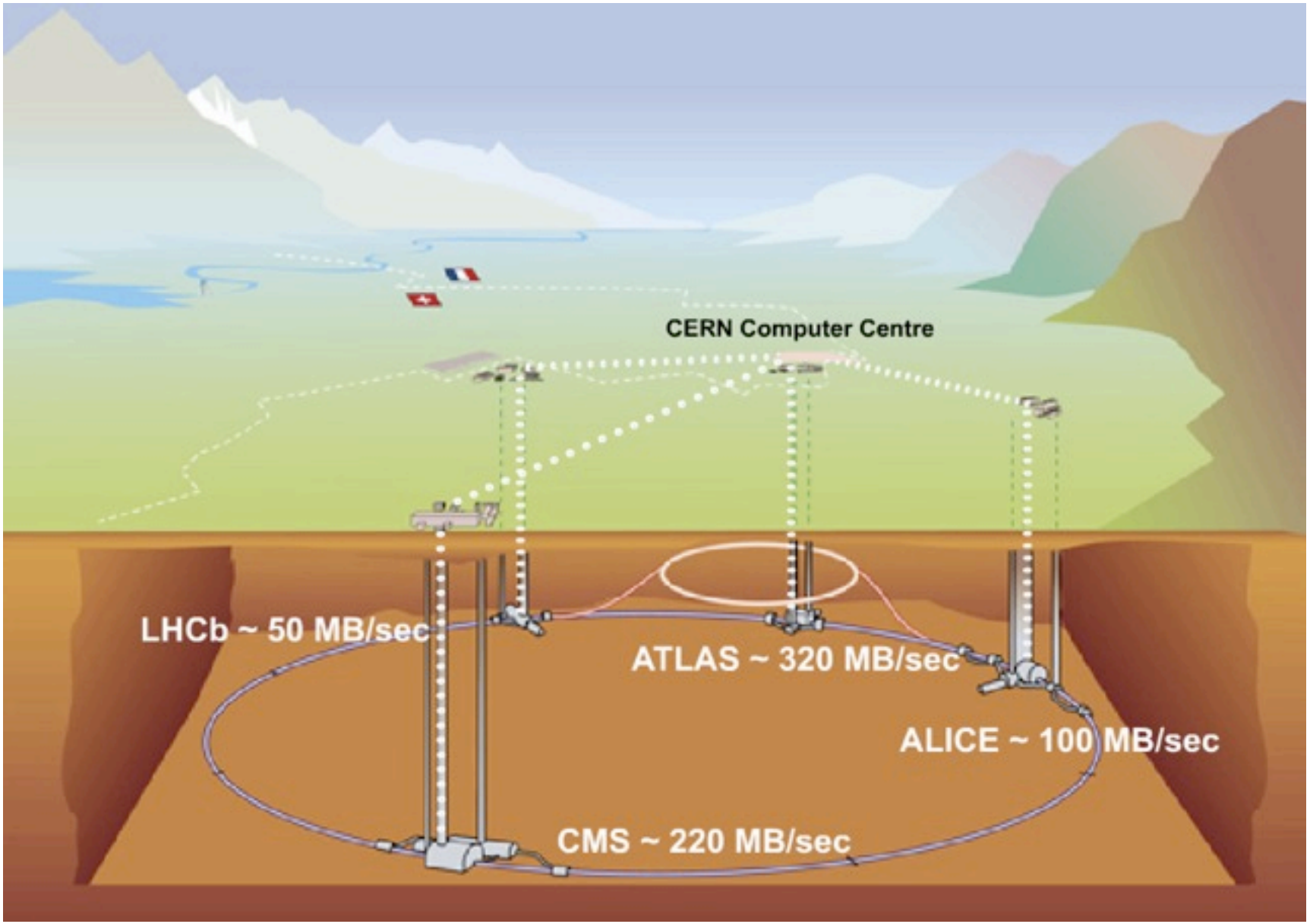
The detectors



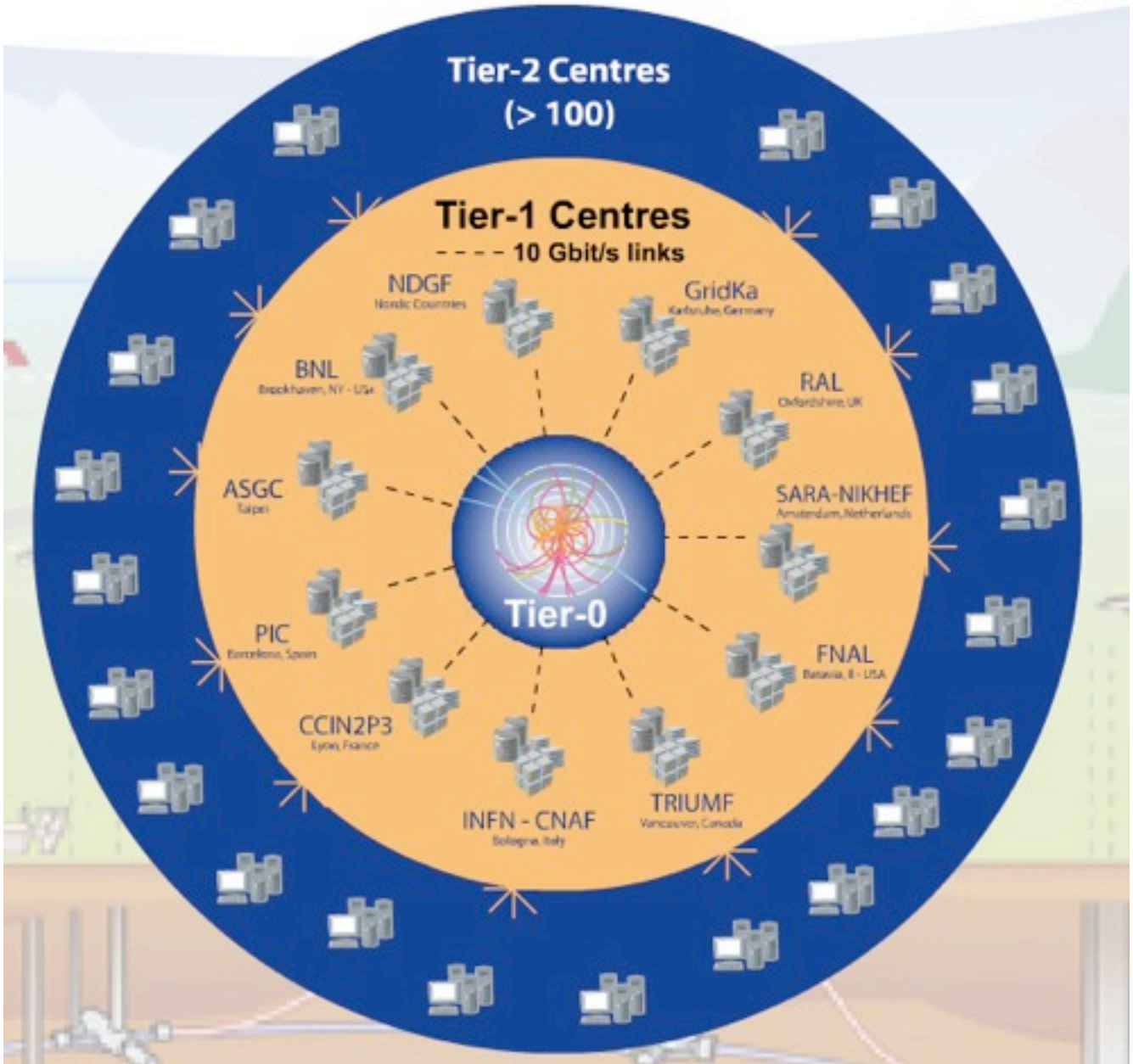
LHC computing

- The aims of LCG is to give to Physicist computing resources able to use the data coming out from the LHC detectors
  - Atlas
  - Alice
  - CMS
  - LHCb
- Estimation of 15 Petabytes of usable data per year
- Average of 0.1 – 1 Go/sec
- We need to process the data around 150,000 cores with at least 2 Gig of RAM per core
- The problematic is unsolvable with one computing centre

Data flow from detectors



Data flow to Tier 1 sites



What is a GRID ?

- **Grid computing is a word in distributed computing domain which can have several meanings:**
  - A local computer cluster which is like a "grid" because it is composed of multiple nodes, batch system and advanced network storage
  - Offering online computation or storage as a metered commercial service, known as utility computing, computing on demand, or cloud computing, Amazon EC2
  - The creation of a "virtual supercomputer" by using spare computing resources within an organization, BOINC
  - **The creation of a "virtual supercomputer" by using a network of geographically dispersed computers. Volunteer computing, which generally focuses on scientific, mathematical, and academic problems, is the most common application of this technology (Wikipedia definition)**

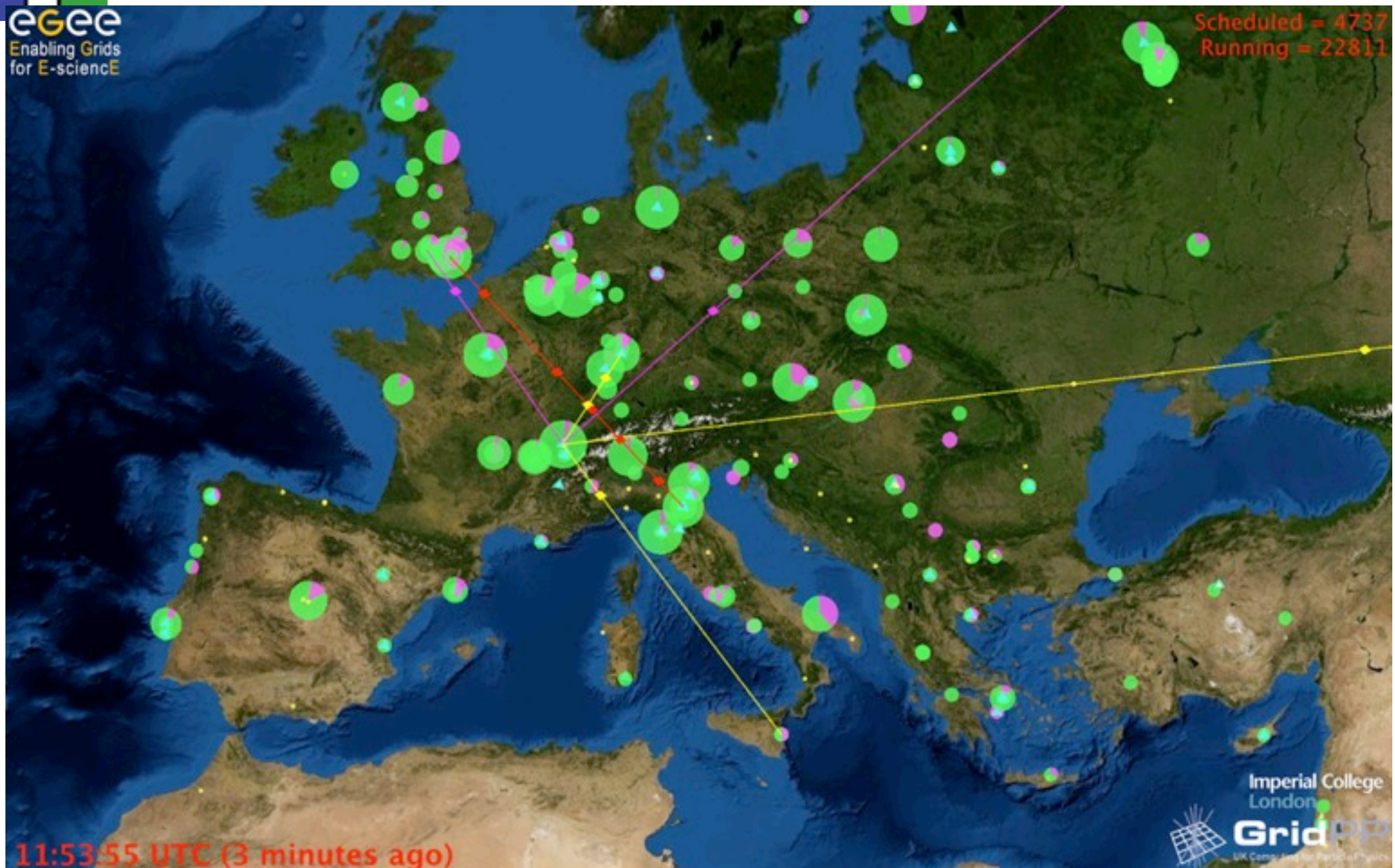
But why a GRID for LHC ?

- Multiple copies of data that can be kept in different sites
- Optimum use of spare capacity of all CC in the project
- No single point of failure
- The cost of maintenance and upgrade is also distributed
- Diversity in the way to use computing resource
- The system can be partially change and reconfigure depending of the user requirement
- Flexibility in deciding how and where to provide future computing resources
- Sharing of the knowledge of new technologies
- Cost sharing resources in different places permit a reduce of cost by using the existing structure

LHC computing *Grid*

- **What is LCG :**
  - The architecture choose for processing LHC data
  - A deployment team of 300 persons
  - Application support for the 4 experiments
  - A team of data storage experts
  - Status 31st July 2009
    - 283 sites
    - 67k jobs / per week
- **Maintenance :**
  - Monitoring all sites every 4 hours
  - Information about sites status renew every 7 minutes
  - Continental support for computing centers
  - Tracking problems for a worldwide service

LCG/EGEE Grid



Louis Poncet IT/GD

WLCG software

- gLite middleware
- ARC middleware
- OSG middleware
- Fabric management
- Monitoring tools
- Physics software
  - ROOT (data analysis advance framework)
  - POOL (data management)
  - ARDA (A Realisation of Distributed Analysis)
- Networking
  - Links between Tier 0 > Tier 1

Coordination

WLCG context

- **WLCG is a collaboration of various grid organisations**
  - EGEE (Enabling Grid for E-SciencE)
  - OSG (Open Science Grid)
- **National and regional Grid structure**
  - GridPP (UK)
  - INFN Grid (Italy)
  - NorduGrid (Nordic region)
- **Part of the Globus Alliance**
  - involve in the support of Globus and uses the Globus-based Virtual Data Toolkit
- **Work with industry**
  - in particular through the CERN openlab

Problems

- **A Grid install on 283 sites is really hard to maintain**
  - New version of the middleware require lot of sysadmin attention
  - Each centre are unique with pretty long history
  - They always need to check that the middleware does not affect other activities of there computing centers
- **We have problem to get the properly compiled part of the middle-ware**
- **Monitoring and test has to be really close to the evolution of new functionality of the middleware**
- **Where the problems come from :**
  - Configuration of the middleware
  - Bug in the code of the middleware
  - Site configuration : Os, network infrastructure, security local policy, national computing severity policy.

Questions

Links

- **Monitoring tools :**
  - http://gridportal.hep.ph.ic.ac.uk/rtm/
- **CERN LCG website**
  - http://lcg.web.cern.ch/LCG/
- **GRID Cafe**
  - http://gridcafe.web.cern.ch/gridcafe/
- **NOVA science physics program**
  - http://www.pbs.org/wgbh/nova/sciencenow/3410/02.html
- **OpenScienceGrid**
  -

Achievements

- **Results :**
  - Data transfer worldwide record
    - “First 500 Terabytes Transmitted via LHCGlobal Grid” (Slashdot Apr 25 2005).
  - Around 30K cpus on the grid active from 150 to 270 active site, 14 petabytes.
  - Around 30K jobs running per day.
  - BIOMED has used 420 Years of CPU time Worth of Data within 4 Months (Slashdot Sep 17 2007).
- **Interoperability :**
  - Interoperation with OSG is perfectly working.
  - Interoperability with NAREGI ready.
- **Quality of cooperation increase every day.**