A major tool to serve research

IHEP Delegation – June 10, 2014

CCIN2P3

cnrs

General Overview

People: 90

National Institute for Nuclear Physics and Particle Physics

CC-IN2P3 gathers the heavy computing resources for:
- Nuclear Physics
- Particle Physics
- Astroparticle Physics

Dedicated Computing Center

Commissariat à l'Energie Atomique

IN2P3, one of CNRS Institutes

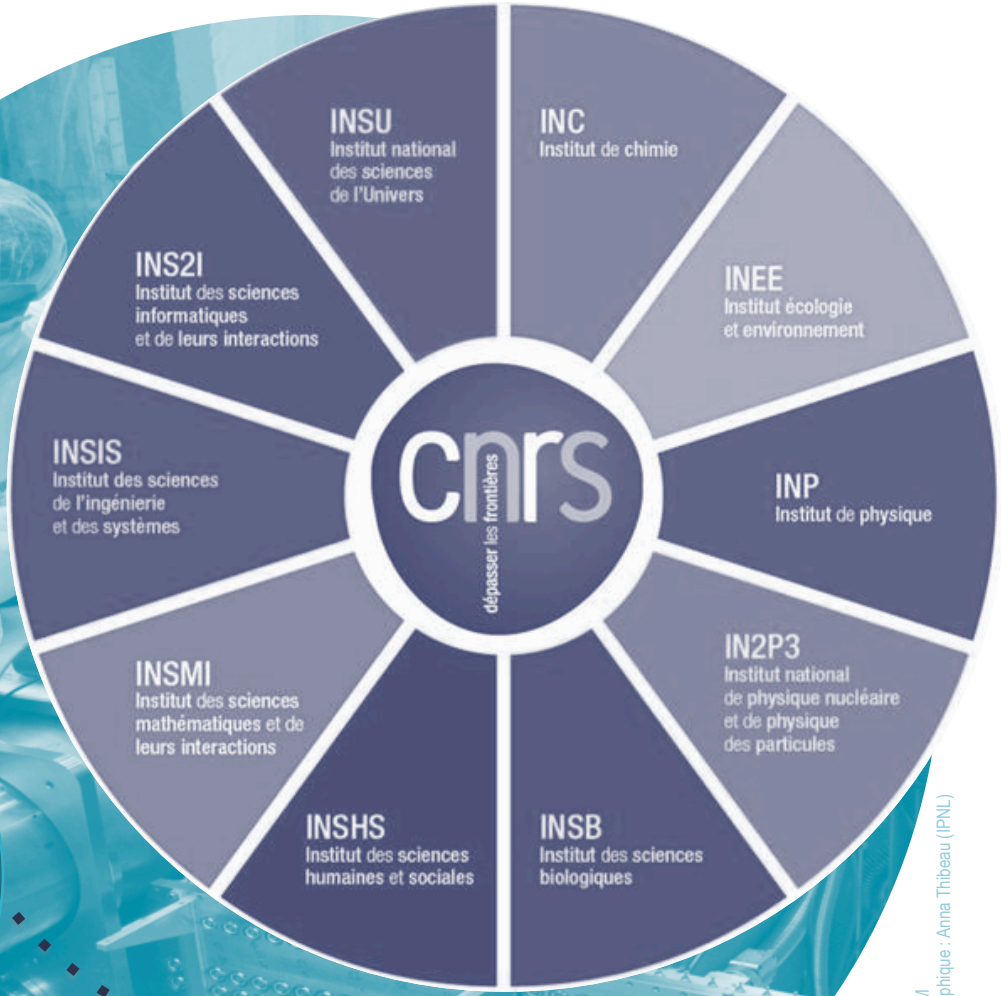
cnrs IN2P3
The two infinities

The CNRS

10 institutes (**3** national institutes: INSMI, INSU, IN2P3)
1,100 research units
(95% in partnership)

34,000 *researchers, engineers, technicians*

€3.3 billion
budget



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Conception graphique : Anna Thibeau (IPNL)

Scientific themes

Particle physics
Nuclear and hadronic physics

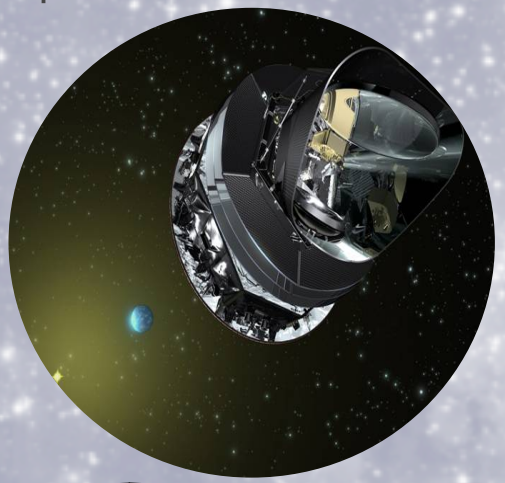
Matter's most elementary constituents and fundamental interactions

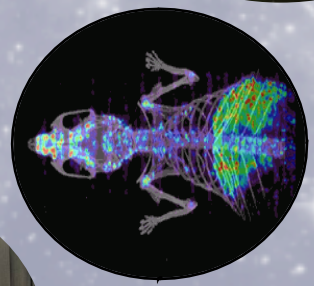
Structure of nuclear matter

Theory
Instrumentation
Computing grids
Accelerator R&D
Back-end of the nuclear fuel cycle and nuclear energy
Medical applications

Astroparticle physics and neutrinos

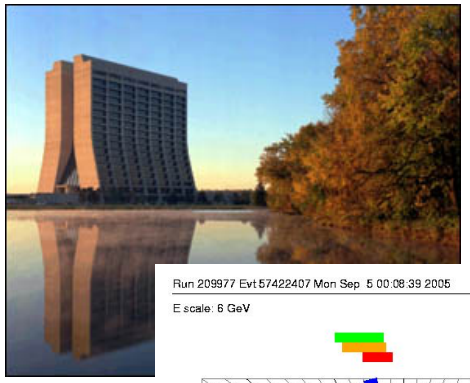
Universe's composition and behaviour

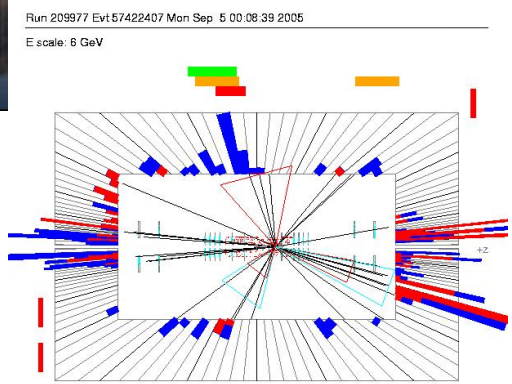




© Ganil, Cern, CC-IN2P3, Guinevere, Amissa, Planck, LSM – Conception graphique : Anna Thibeau (IPNL)

CC-IN2P3, one link in the chain of production of scientific results





Physics experiments

- Nuclear Physics
- Particle Physics
- Astroparticle

Fundamental Research

Big Data

101000 100111
0001001010001 00011101
100010001111 00010 101000
100111 0001001010001
00011101 100010001111
00010 101000 100111
110001 111010
0001001010001101000
100111 0001001010001
00011101 1110
100010001111 00010 101000

Publications

FERMILAB-CONF-
CDF/PUB/CDF/PUBI
November

Electroweak, Top and Bottom Physics at the Tevatron

FUMIHIKO UKEGAWA (CDF Collaboration)

Institute of Physics, University of Tsukuba
Tennoudai 1-1-1, Tsukuba-shi, Ibaraki-ken 305-8571, Japan
E-mail: ukegawa@hep.px.tsukuba.ac.jp

representing the CDF and D0 collaborations

ABSTRACT

The Tevatron Run-II program has been in progress since 2001, and the CDF and D0 experiments have been operational with upgraded detectors. Coupled with recent improvements in the Tevatron accelerator performance, the experiments have started producing important physics results and measurements. We report these measurements as well as prospects in the near future.

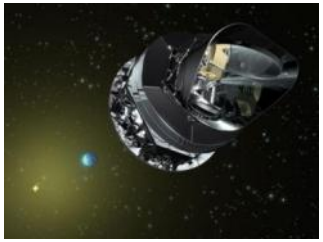
v1/0411012 v2 12 Nov 2004

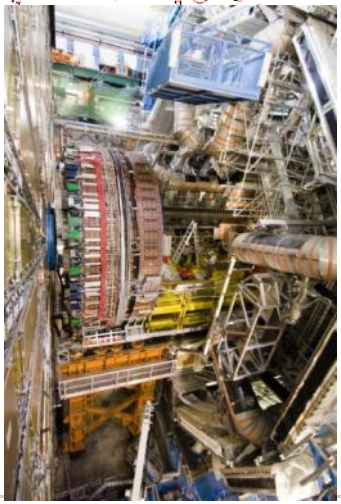
Analysis of the results

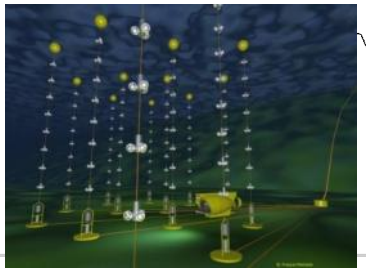
Data Analysis

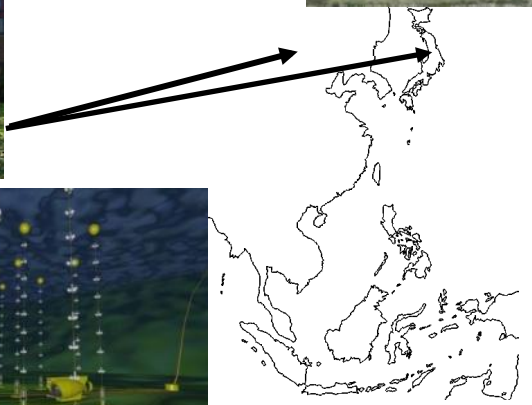
An international dimension

CC-IN2P3 is part of a worldwide network of large computing centers for High Energy Physics







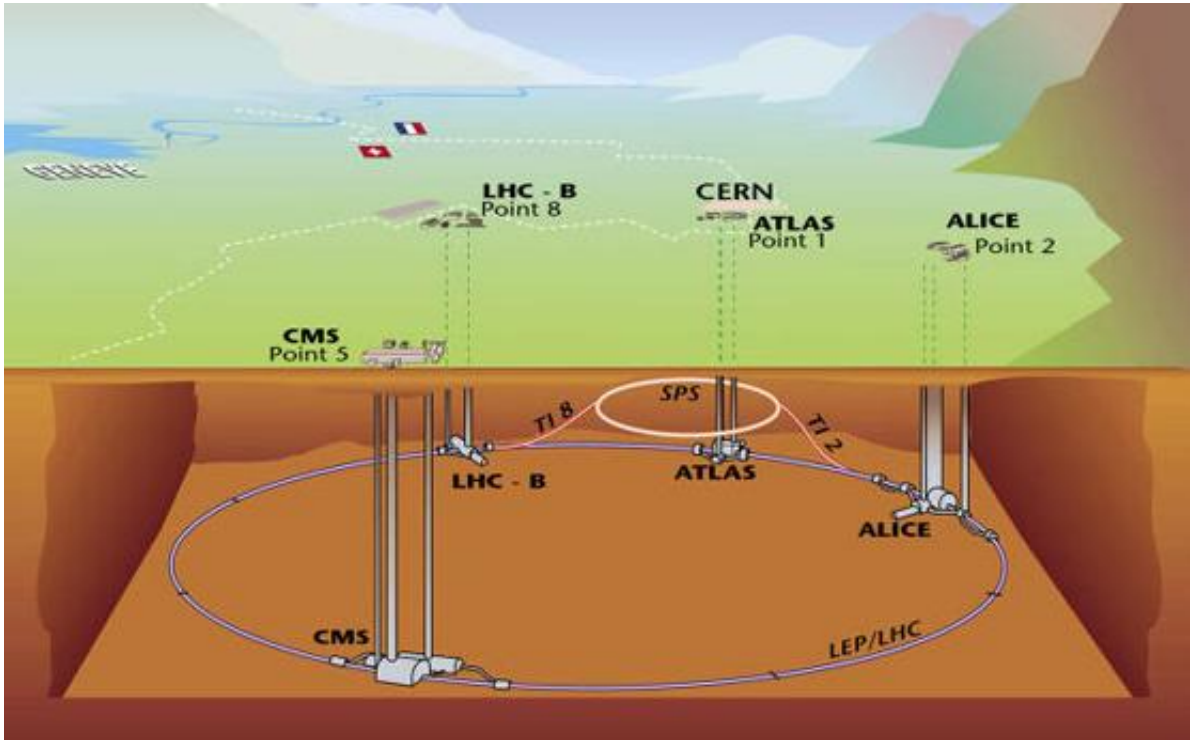


Why physics experiments need a computing center?

- Complex experiments
  - Very large number of electronic channels
    - ➔ Large amounts of data
- International collaborations
  - Data distribution
  - Geographically distributed analysis
    - ➔ Leveraging wide area networks
- Experiments are simulated too
  - Complex modeling of detectors' responses
    - ➔ Large computing times and amounts of data

LHC, a giant particle accelerator

LHC = Large Hadron Collider



Two proton beams circulating in opposite directions

Collisions in 4 zones

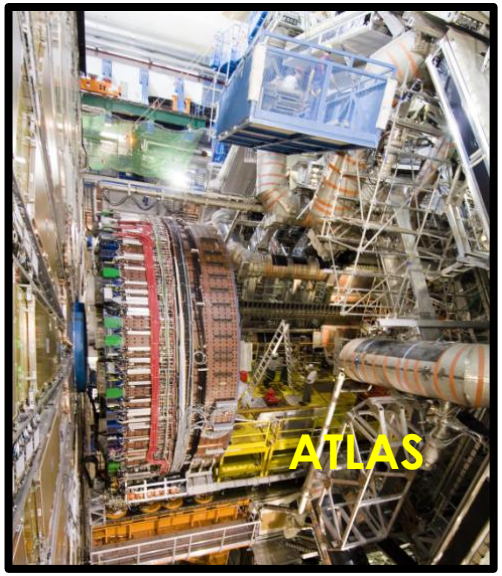
10 years to be build

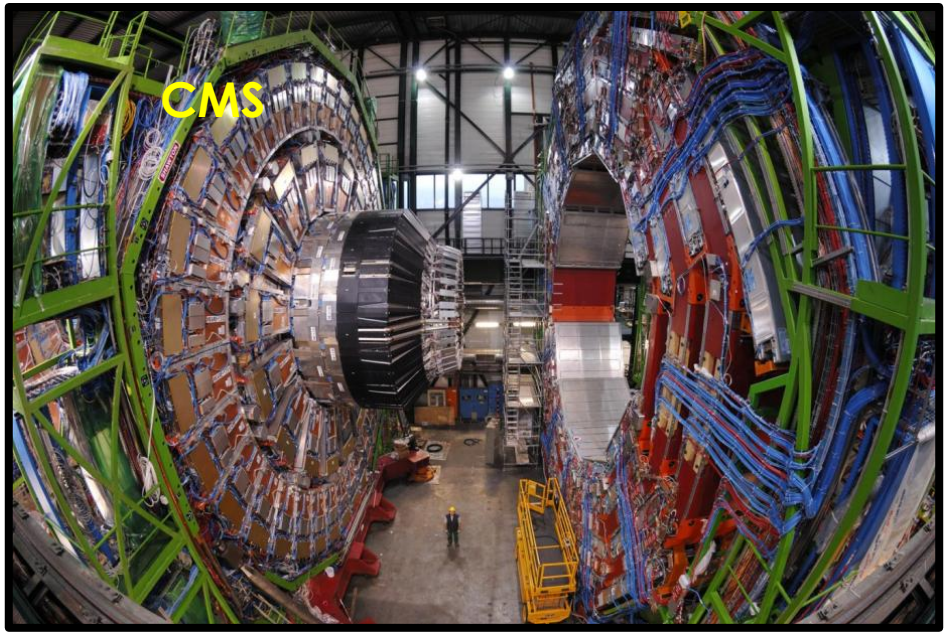
Several thousands of physicists and engineers involved worldwide

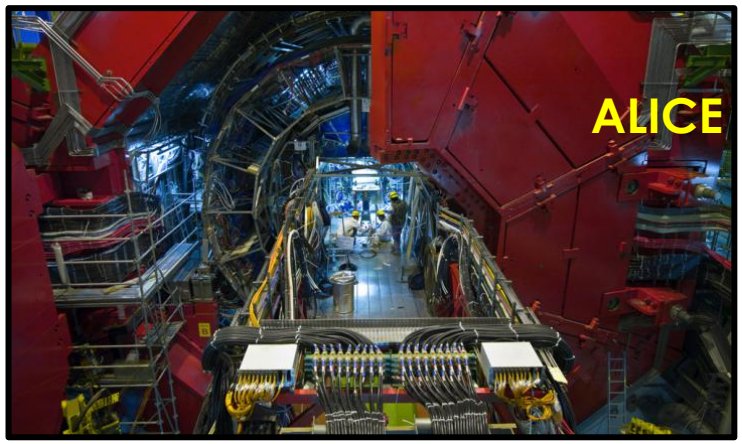
Instrument Cost: ~3 billions €

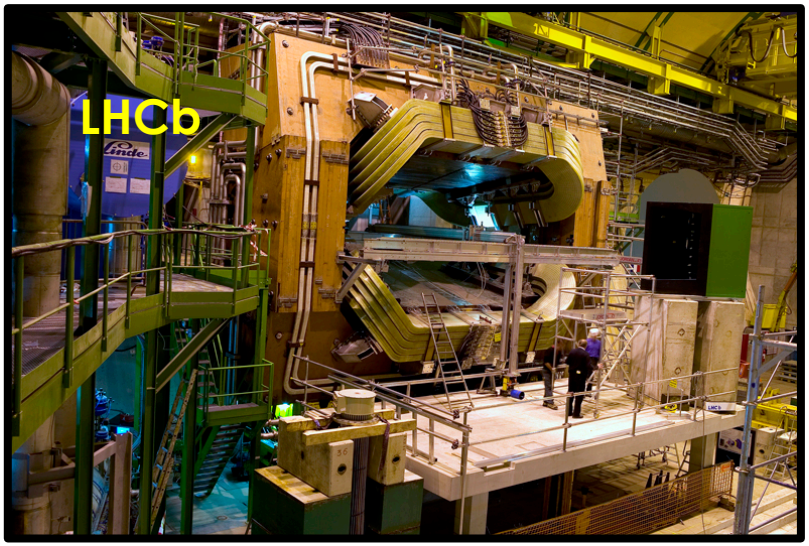
More than 9,000 supraconductive magnets

LHC: one tunnel and four huge detectors









15 petabytes of data

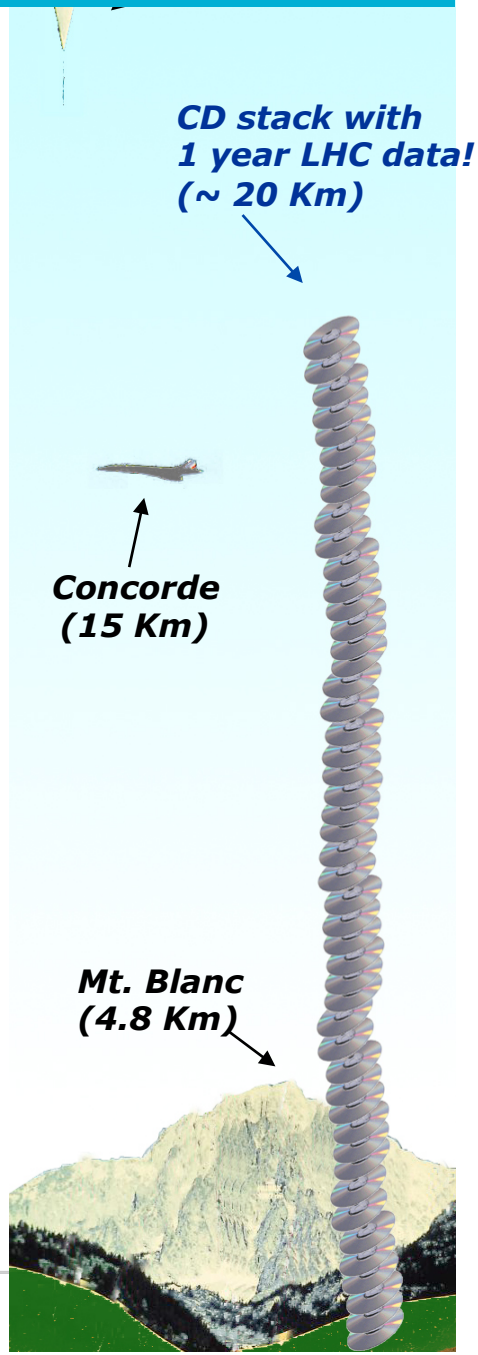
1 typical hard drive: 500 GB
1 year of LHC production ➔ 30,000 HDD

100 millions of SpecInt2000 are needed to process this data

Roughly 70,000 modern CPUs

Centralized data processing is not an option!

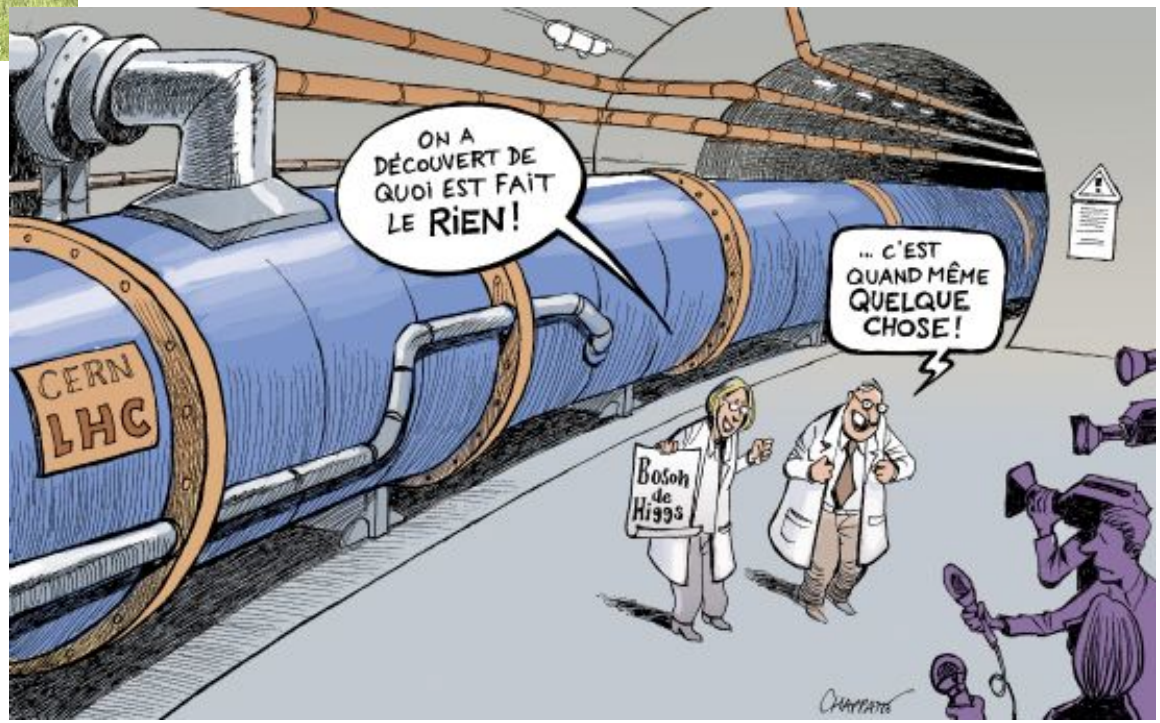
➔ Agregating the available computing power of several computing centers is mandatory



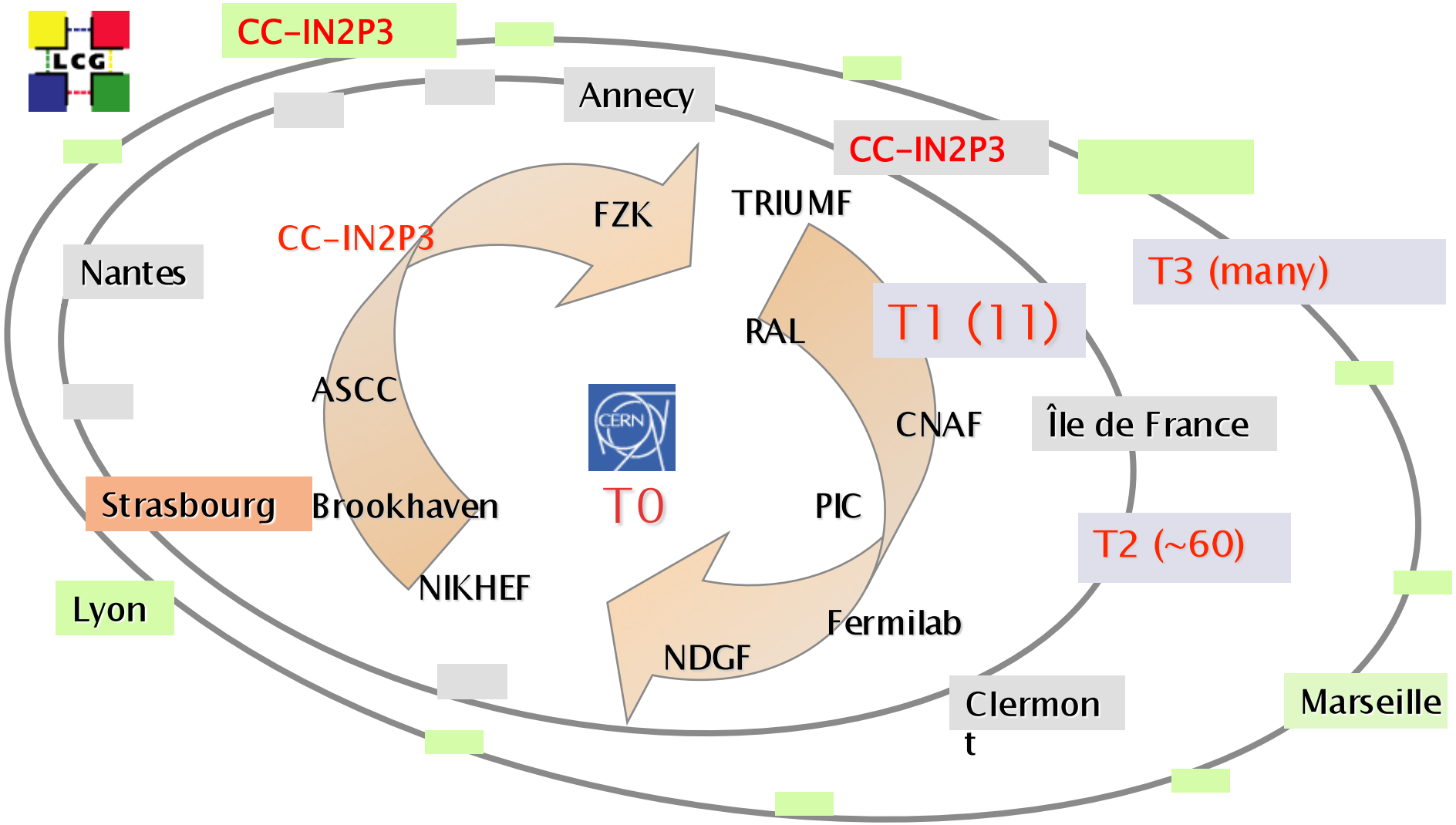
A needle…in a haystack

Part of physicists' work consists in looking at billions of collisions to find the few dozens that will unveil interesting phenomena

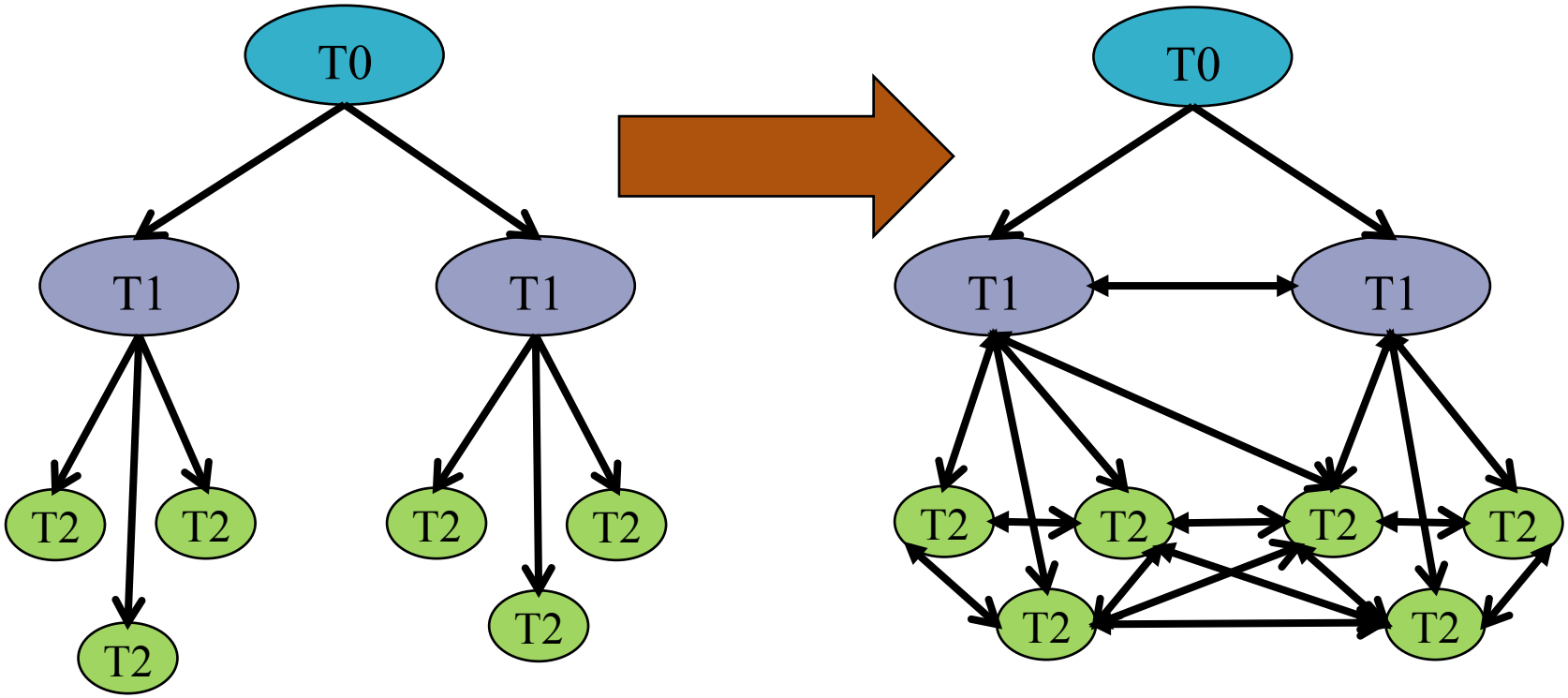
-> Higgs Boson discovery (July 2013)



A specific grid infrastructure for LHC – the WLCG Project

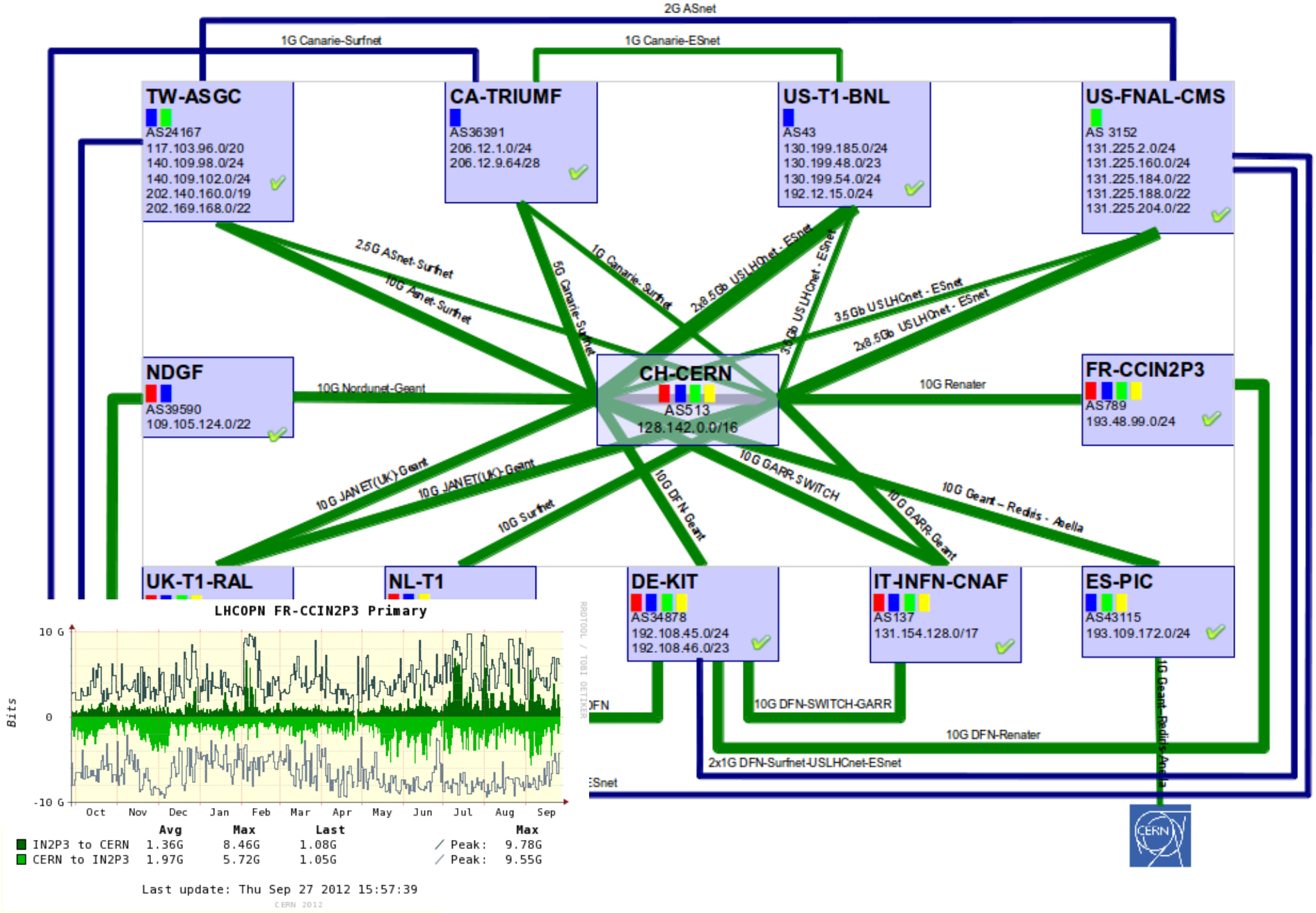


Evolution of the computing model



➔ LHC Open Network Environment Project

LHCOPN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1G Canarie-Surfnet
1G Canarie-ESnet
TW-ASGC
AS24167
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140.109.98.0/24
140.109.102.0/24
202.140.160.0/19
202.169.168.0/22
CA-TRIUMF
AS36391
206.12.1.0/24
206.12.9.64/28
US-T1-BNL
AS43
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130.199.48.0/23
130.199.54.0/24
192.12.15.0/24
US-FNAL-CMS
AS 3152
131.225.2.0/24
131.225.160.0/24
131.225.184.0/22
131.225.188.0/22
131.225.204.0/22
2.5G ASnet-Surfnet
10G Asnet-Surfnet
5G Canarie-Surfnet
10G Canarie-Surfnet
2x8.5Gb USLHCnet - ESnet
3.5Gb USLHCnet - ESnet
3.5Gb USLHCnet - ESnet
2x8.5Gb USLHCnet - ESnet
NDGF
AS39590
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10G Nordunet-Geant
CH-CERN
AS513
128.142.0.0/16
10G Renater
FR-CCIN2P3
AS789
193.48.99.0/24
10G JANET(UK)-Geant
10G JANET(UK)-Geant
10G Surfnet
10G DFN-Geant
10G GARR-SWITCH
10G GARR-Geant
10G Geant – Redlis - Abella
UK-T1-RAL
NL-T1
DE-KIT
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192.108.46.0/23
IT-INFN-CNAF
AS137
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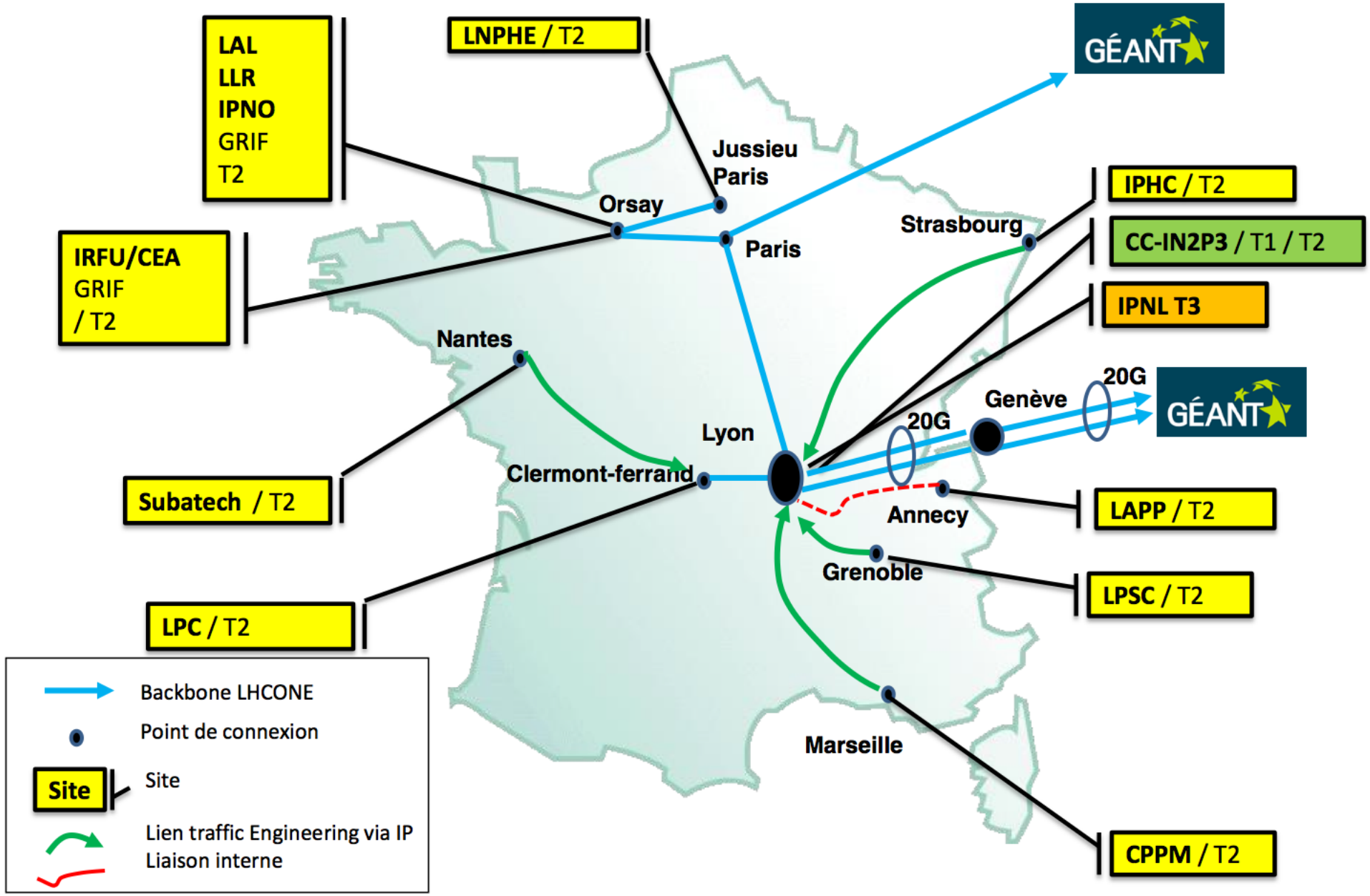
10G DFN-SWITCH-GARR
10G DFN-Renater
2x1G DFN-Surfnet-USLHCnet-ESnet
10G Geant-Redlis-Abella
CERN

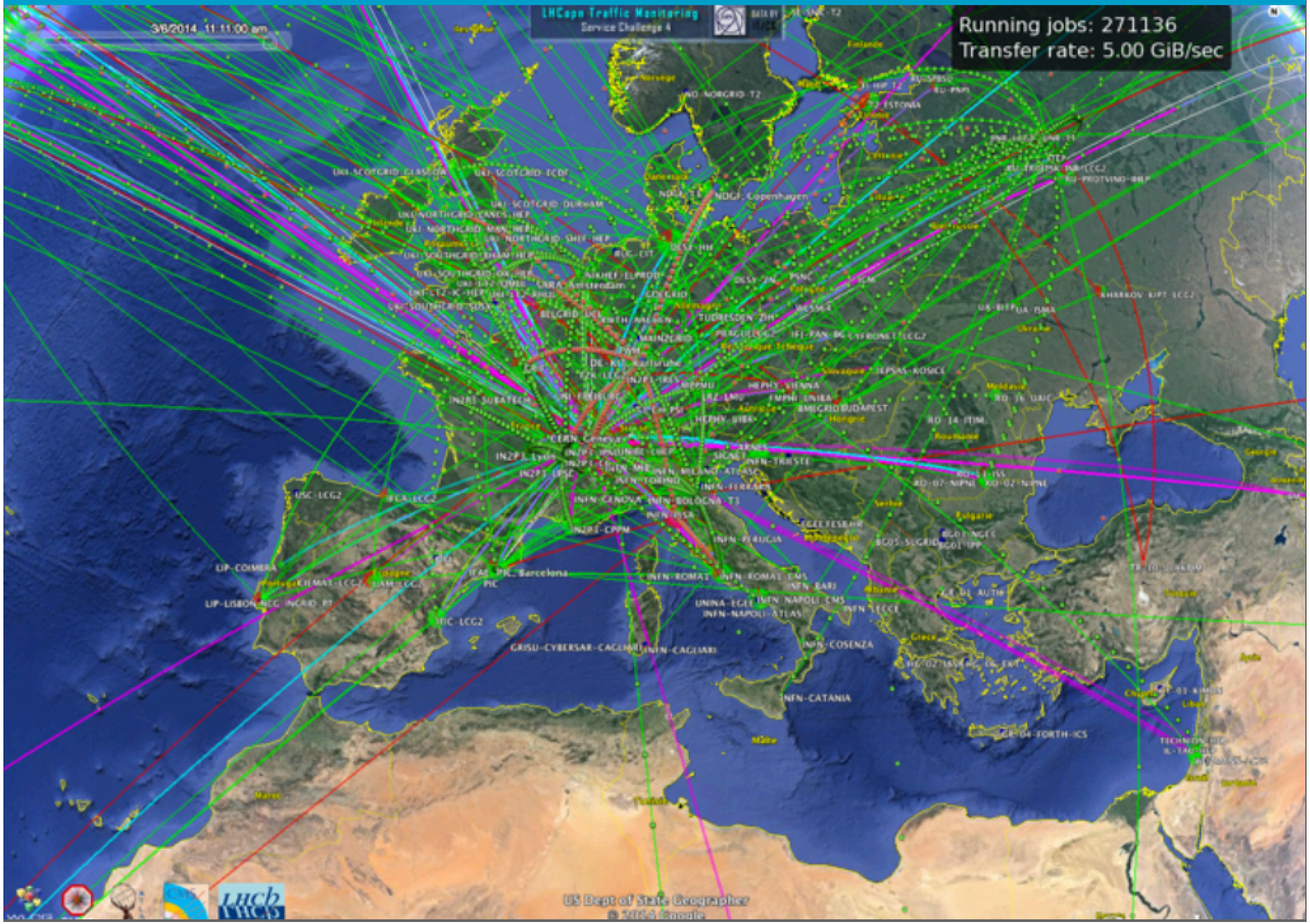
LHCOPN FR-CCIN2P3 Primary
10 G
0
-10 G
Bits
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Avg
Max
Last
Max
IN2P3 to CERN 1.36G 8.46G 1.08G Peak: 9.78G
CERN to IN2P3 1.97G 5.72G 1.05G Peak: 9.55G
Last update: Thu Sep 27 2012 15:57:39
CERN 2012

RENATER
CONNECTEUR DE SAVOIRS

LHCONE nov. 2013



W-LCG



LHCopn Traffic Monitoring
Service Challenge 4
3/6/2014 11:11:00 am
Running jobs: 271136
Transfer rate: 5.00 GiB/sec
NDGF-Copenhagen
CERN-Geneva
INFN-TRIESTE
INFN-FERRARA
INFN-PERUGIA
INFN-ROMA1
INFN-CAGLIARI
INFN-COSENZA
INFN-CATANIA
INFN-NAPOLI-ATLAS
INFN-BARI
INFN-LECCE
INFN-GENOVA
INFN-BOLOGNA-T3
INFN-TORINO
INFN-MILANO-ATLAS
INFN-ROMA1-CMS
INFN-NAPOLI-CMS
UNINA-EGEE
GRISU-CYBERSAR-CAGLIARI
LIP-COIMBRA
LIP-LISBON
USC-LCG2
FCA-LCG2
IFAE-PIC, Barcelona
PIC
IFIC-LCG2
GR-04-FORTH-ICS
KHARKOV-KIPT-LCG2
CYFRONET-LCG2
IEPSAS-KOSICE
BMEGRID-BUDAPEST
RO-14-ITIM
RO-07-NIPNE
RO-02-NIPNE
RO-16-UAIC
US Dept of State Geographer
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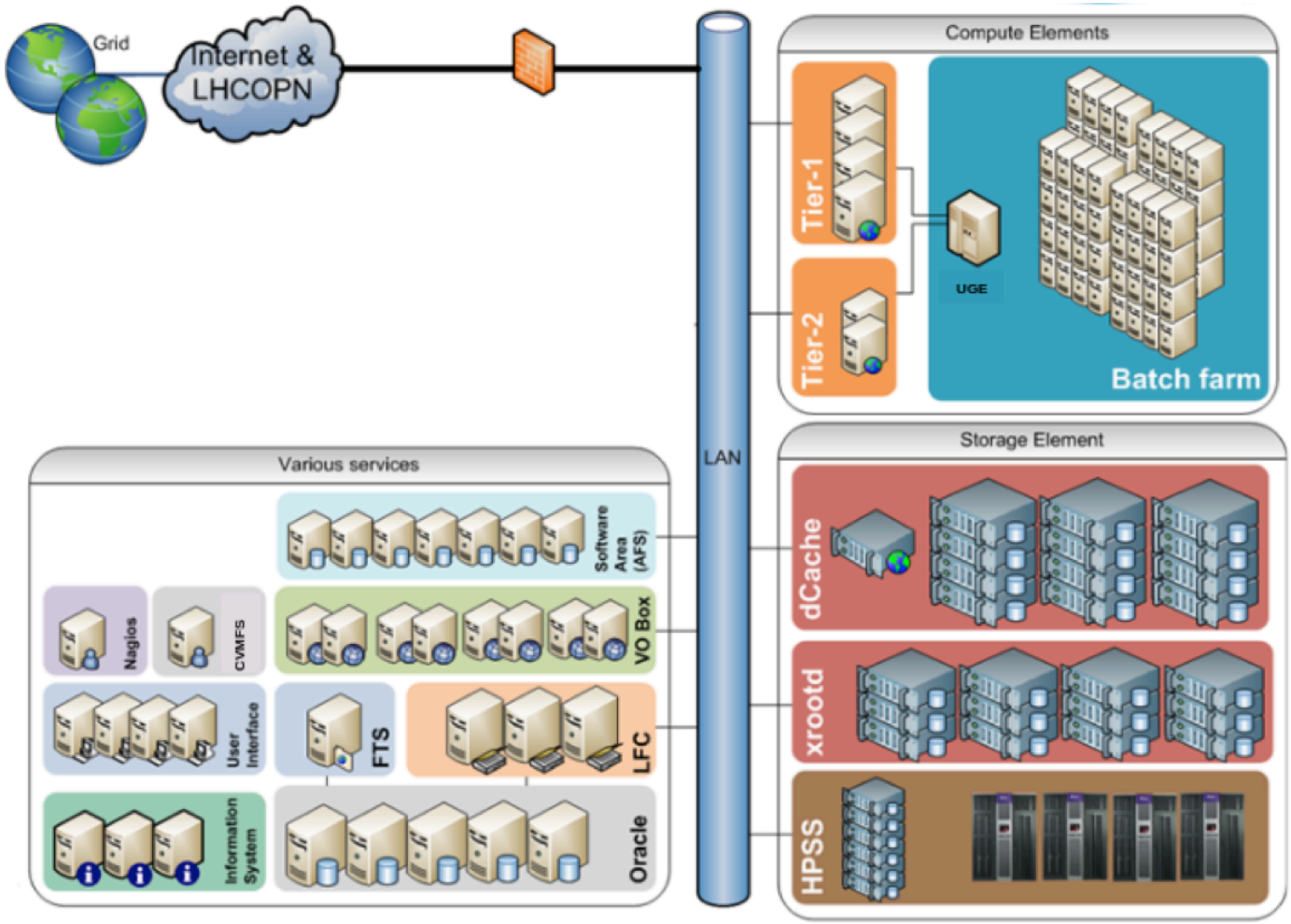
CC-IN2P3 resources for LCG



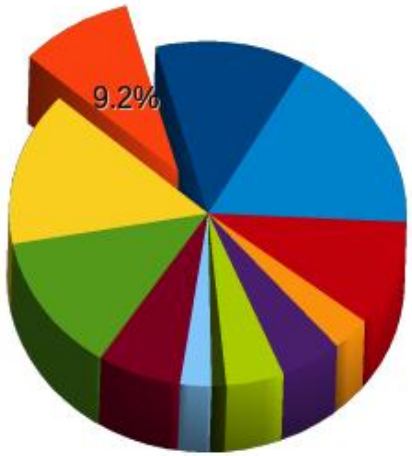
18000 job slots

8 PB disk

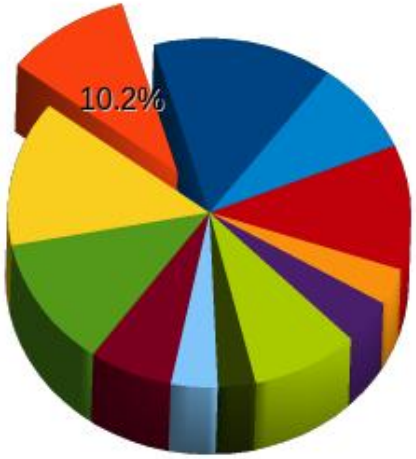
12 PB tape

CC-IN2P3 within W-LCG

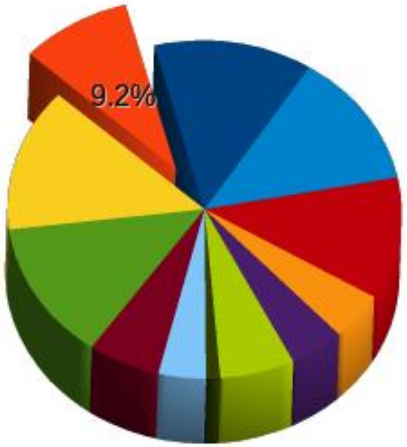
Tier1 Tape



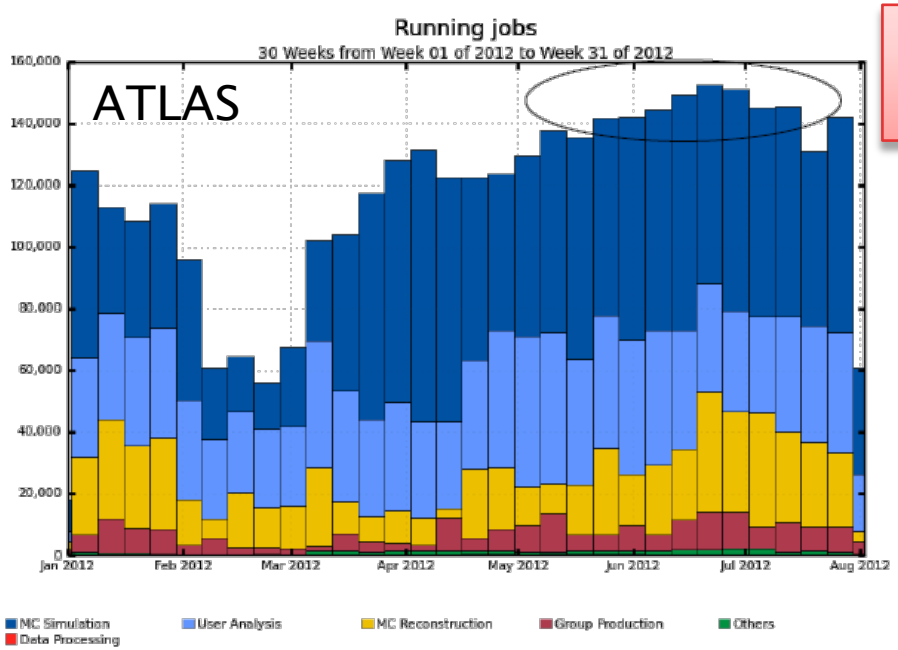
Tier1 CPU



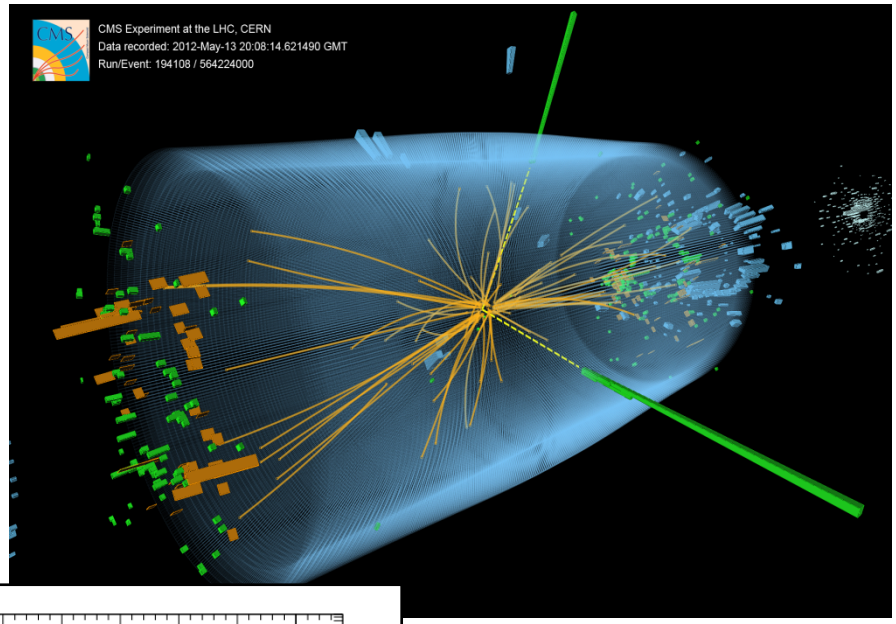
Tier1 Disk

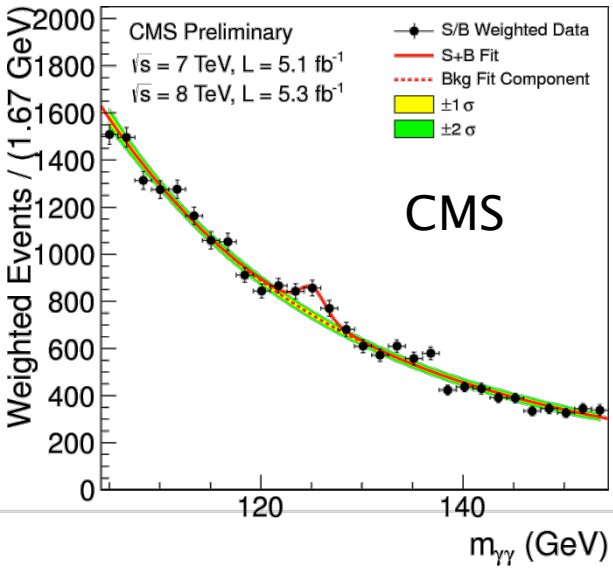


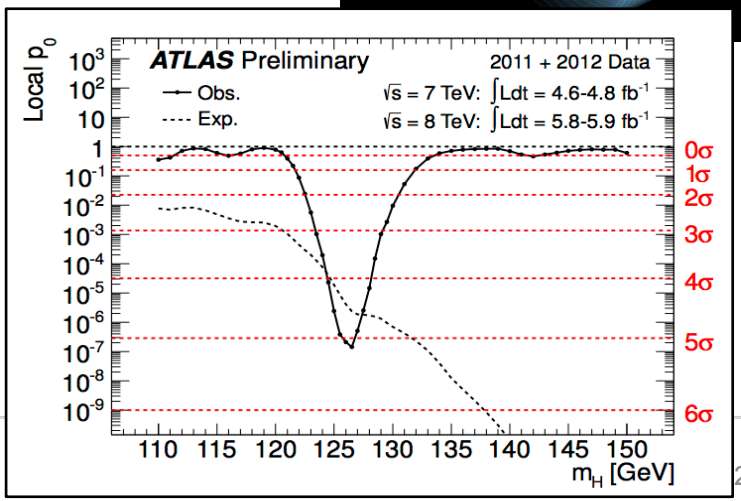
The Higgs field effect… on computing



Intense computing activity between May and July

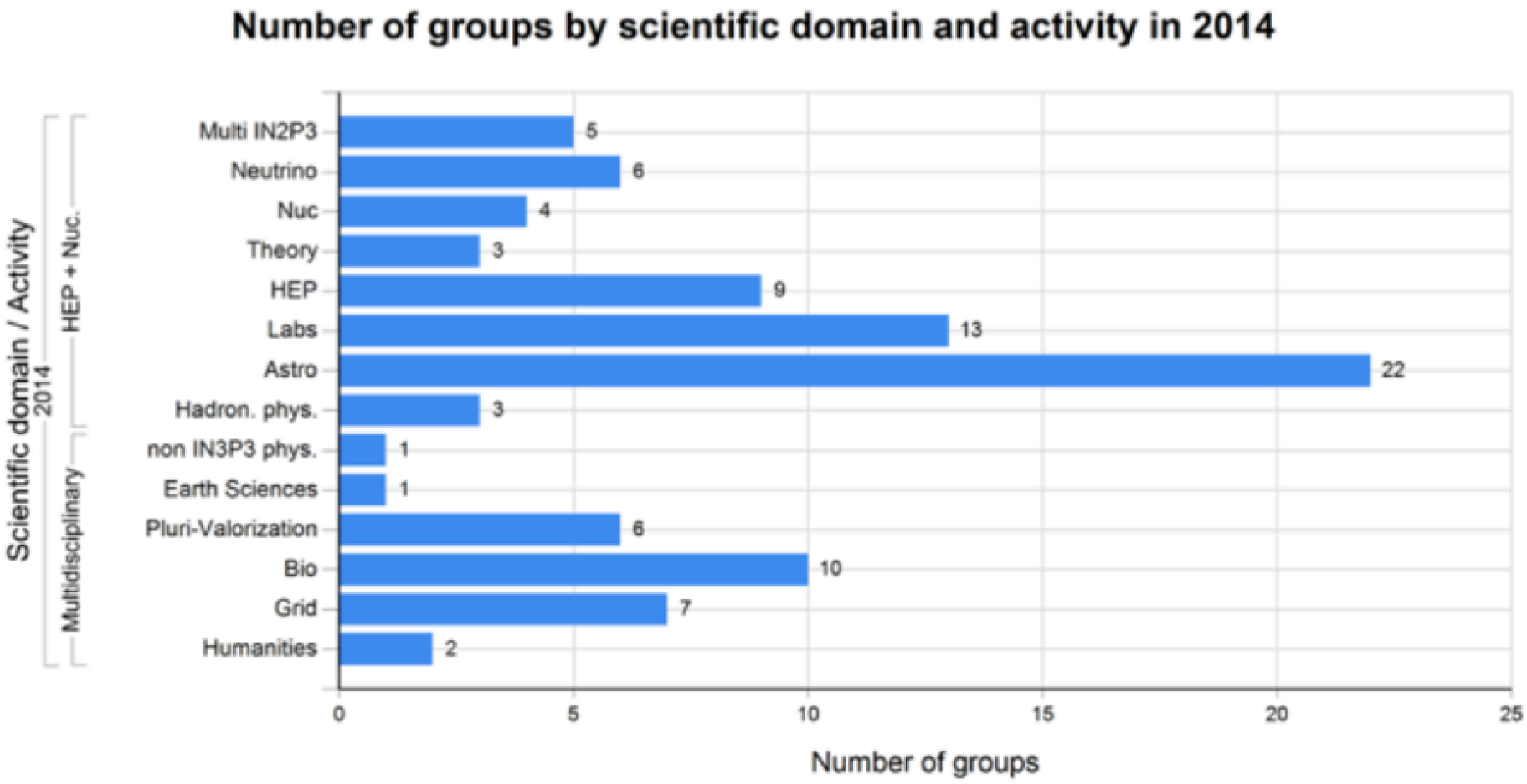




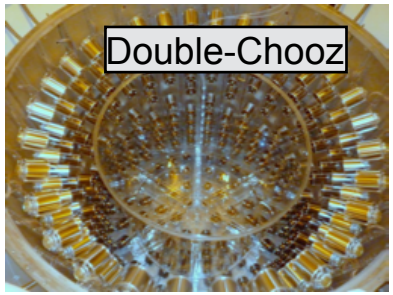


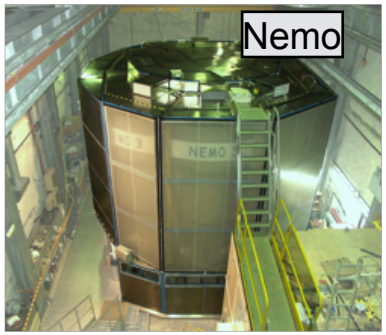
Large recognition of the W-LCG role in the Higgs discovery

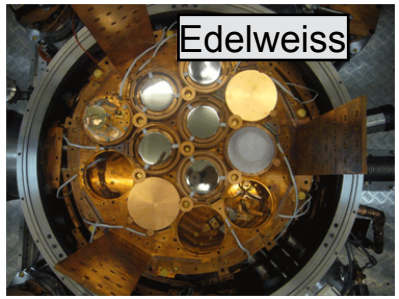
Resource mutualization



Many astroparticle experiments at CC-IN2P3





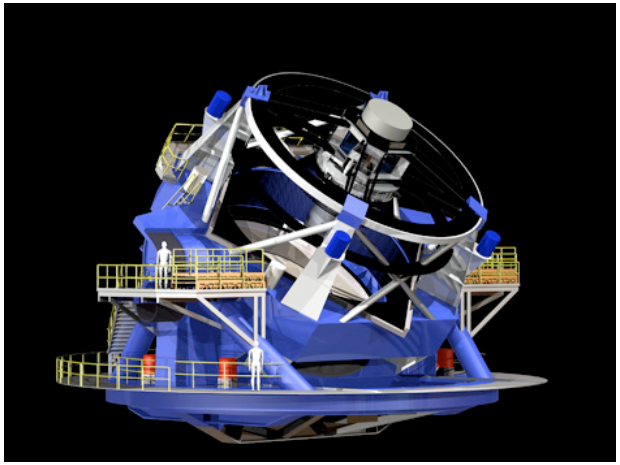


LSST

Whole dataset available at CC-IN2P3

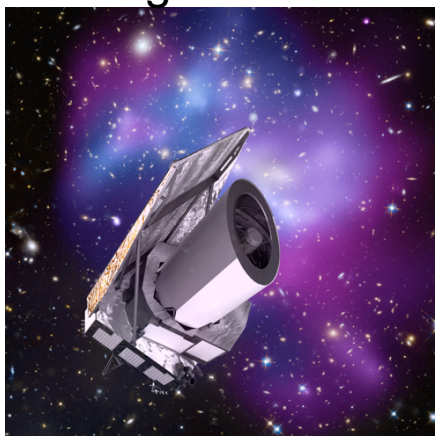
50% of the processing by CC-IN2P3

other 50% by NCSA



EUCLID

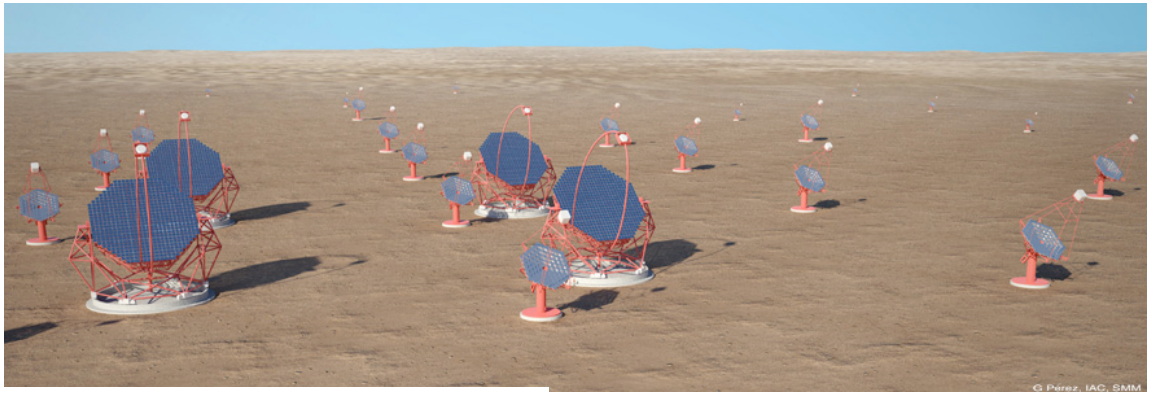
CC-IN2P3 is the French Data Center for processsing and data management



dark energy and dark matter

CTA

CC-IN2P3 should play a key role in the CTA data processing



Gamma rays

Interdisciplinary projects

- Opening to bio scientific field by participating as partners within national or international projects.

- 2 projects:

  - eTRIKS: European project under the aegis of European Initiative IMI
  - BIOASTER: the only TRI (Technology Research Institutes) on health care and life science selected by the National Investments for the Future

- Both projects have in common:
  - Public-private partnership and co-investment
  - Important innovation component to build up new type of platform
  - Staff recruitment

Storage at CC-IN2P3: disk

Hardware

Direct Attached Storage servers (DAS):

- Dell servers (R720xd + MD1200)
- **~ 240** servers
- Capacity: **12 PBs**

Disk attached via SAS:

- Dell servers (R620 + MD3260)
- Capacity: **1.7 PBs**

Storage Area Network disk arrays (SAN):

- IBM V7000 and DCS3700, Pillar Axiom.
- Capacity: **240 TBs**

Software

Parallel File System: GPFS (**1.9 PBs**)

File servers: xrootd, dCache (**10.6 PBs**)

- Used for High Energy Physics (LHC etc…)

Mass Storage System: HPSS (**600 TBs**)

- Used as a disk cache in front of the tapes.

Middlewares: SRM (none), iRODS (**648 TBs**)

Databases: mySQL, PostGres, Oracle **(57 TBs)**

Storage at CC-IN2P3: tapes

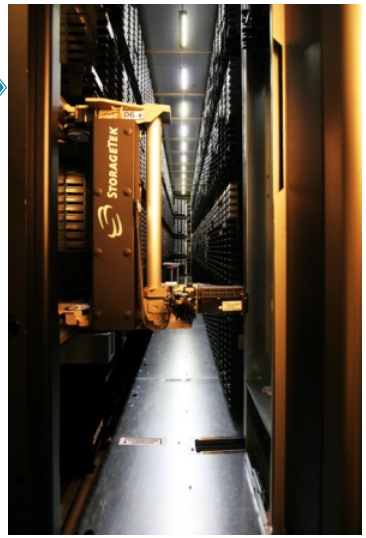
Hardware

4 Oracle/STK SL8500 librairies:

- **40,000** slots (T10K and LTO4)
- Max capacity: **320 PBs** (with T10KD tapes)
- **106** tape drives

1 IBM TS3500 library:

- **3500** slots (LTO6)



Software

Mass Storage System: HPSS

- **24 PBs**
- Max traffic (from HPSS): **100 TBs / day**
- Interfaced with our disk services

Backup service: TSM (**1 PB**)

Quality management

Quality manager appointed

Computer room manager appointed

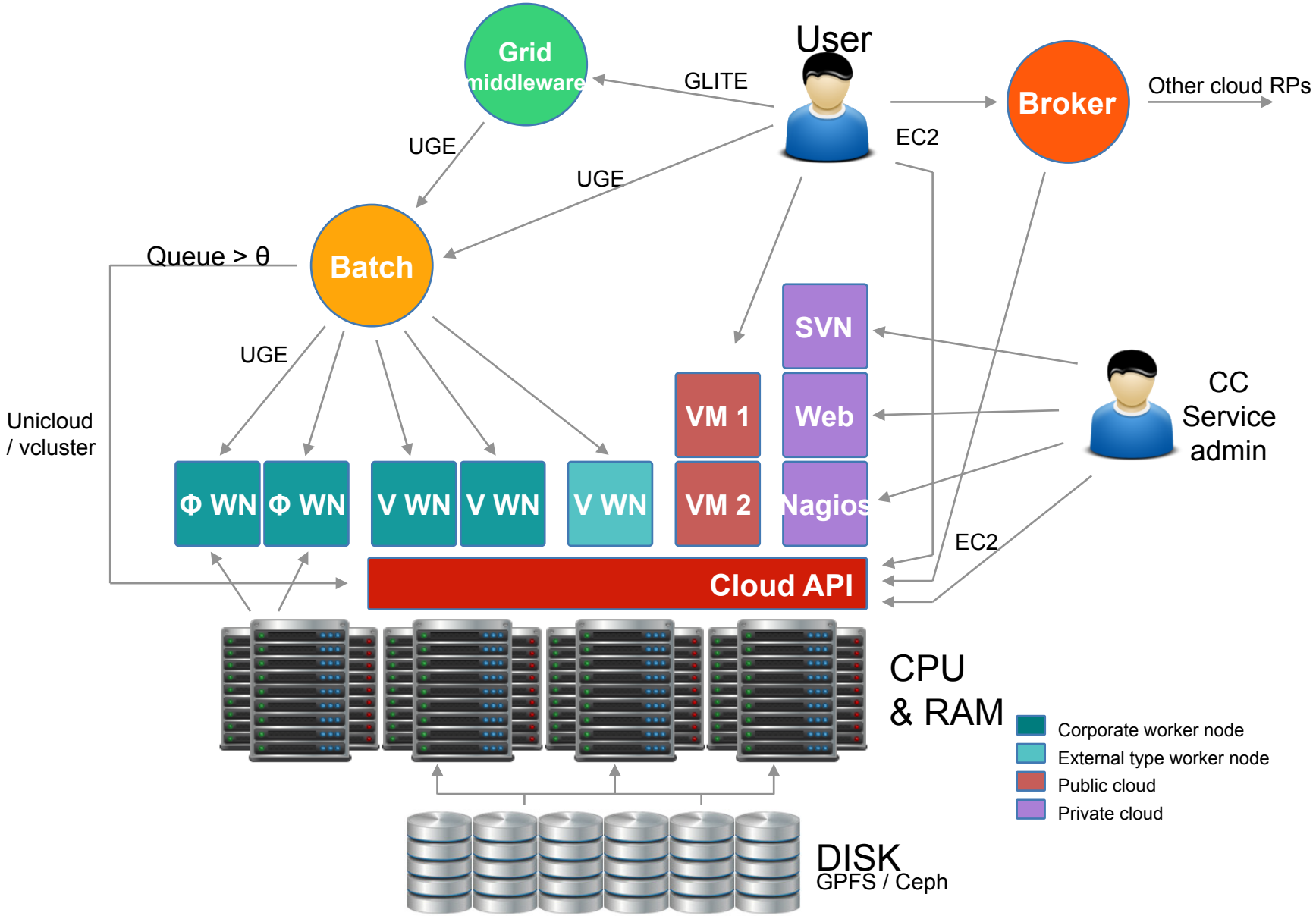
19 people trained to ITIL standards

New OTRS incident tracking system

Big effort in documentation and procedure writing

Next to come : CMDB and Disaster Recovery Plan

IAAS Cloud : toward a unified infrastructure



Cloud implementation: Openstack

Deployment :

- Scientific Linux 6
- RDO packages, Havana release
- Configuration with Puppet

Community cloud cluster :

- 400 cores for test/dev VMs, 100 cores for infrastructure services (DELL C6100)
- 30TB Cinder volumes ~ Amazon EBS (DELL PE R720xd)

Private cloud cluster :

- 100 cores for infrastructure services

Computing cluster :

- 500 cores (DELL M610)

openstack™

Computer Science Research at CC-IN2P3

Team started in 2008

** One permanent member: F. Suter
** Associated to a research team in a CS lab since 2012

Initial Objective

** Build and strengthen links between Computer Scientists and users of large-scale DCIs in production

Research Topics

** Simulation of parallel and distributed HPC systems and applications
** Modeling and simulation of storage
** Workflow scheduling

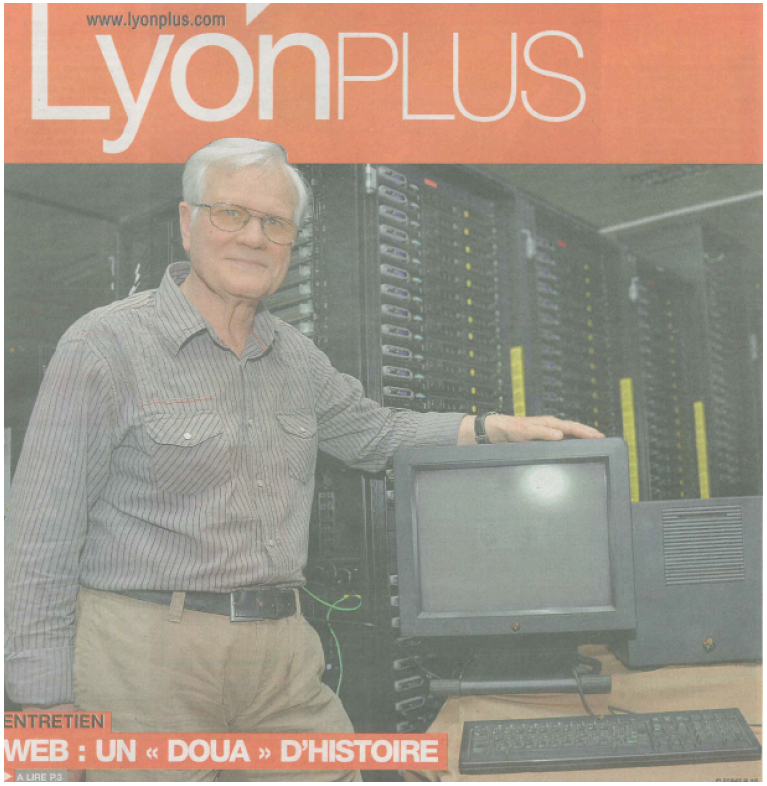
Perspectives

** Apply research results to applications from the physics domain
    -> Collaboration with the SNFactory experiment
** Bring expertise on HPC to physics collaborations
    -> Act up stream to be effective in the decision process

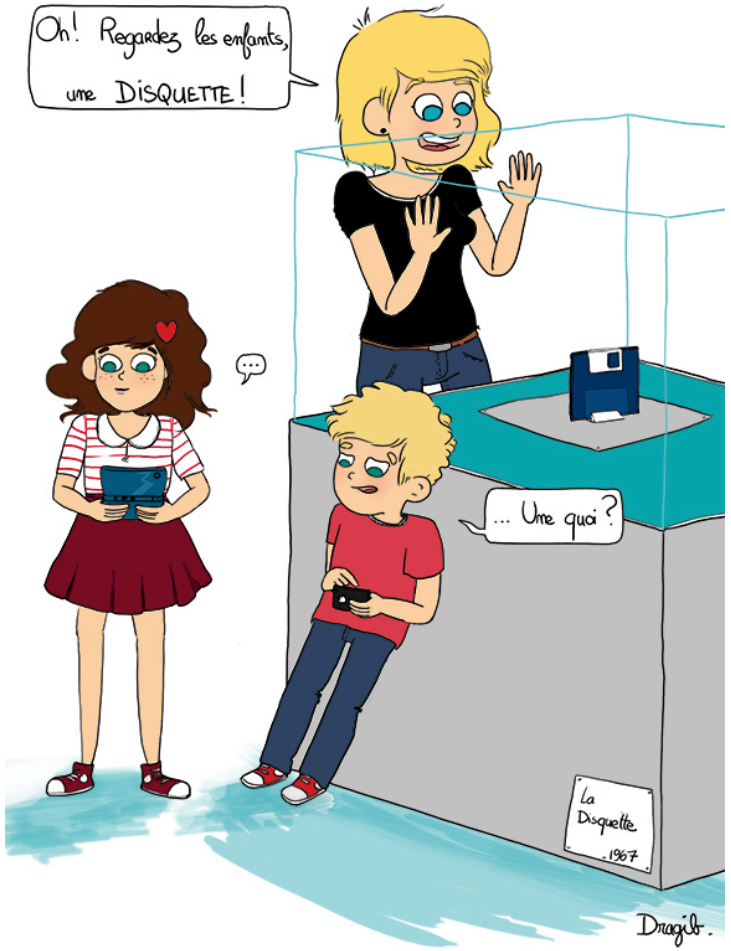
The first French server is born at CC-IN2P3

WWW was born at CERN by and for physicists in 1992…

… closely followed by CC-IN2P3's first French web server



Computing Museum of CC-IN2P3



CC-IN2P3 in Spirou famous comic book