LCG-France
Grid computing for LHC

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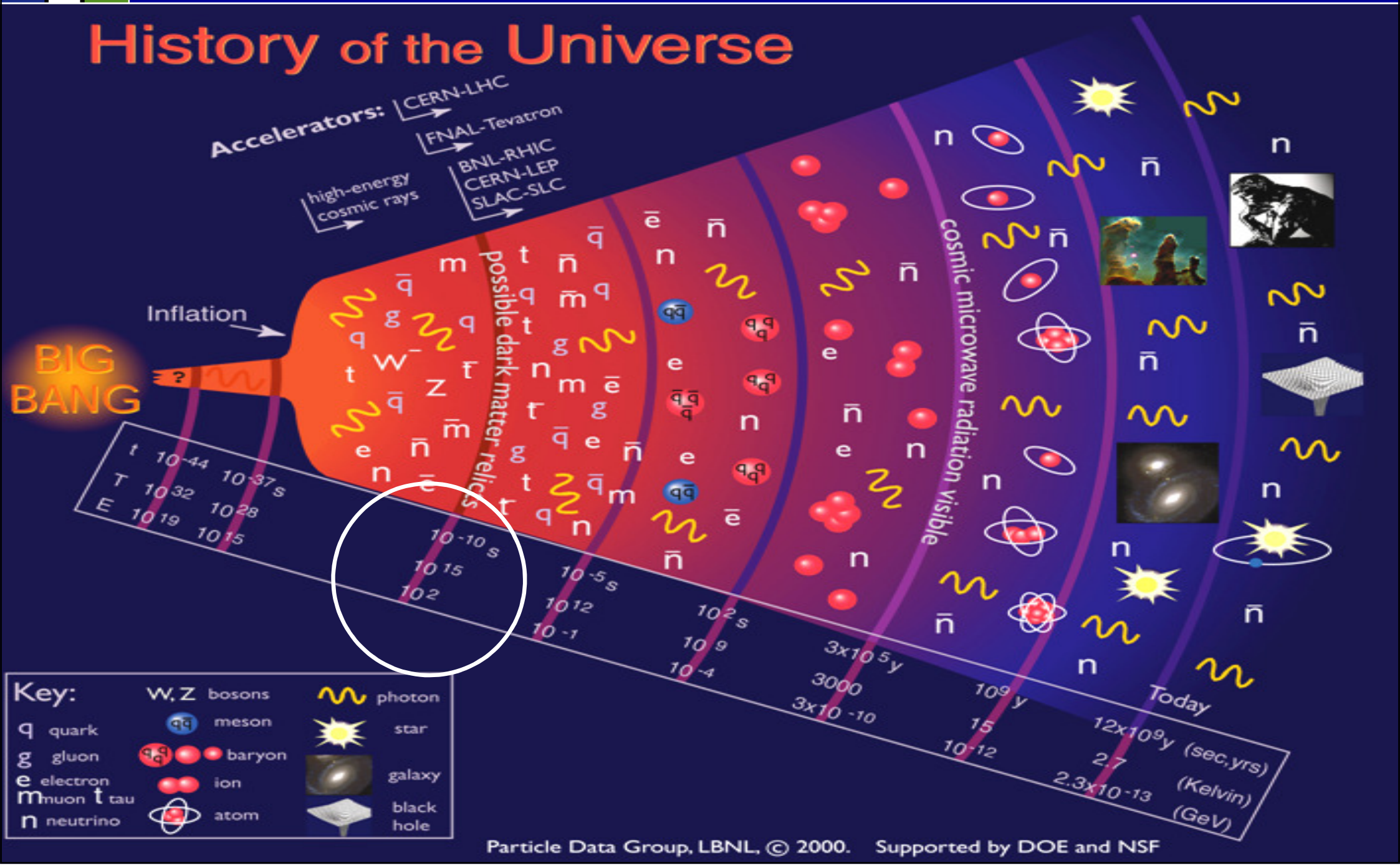
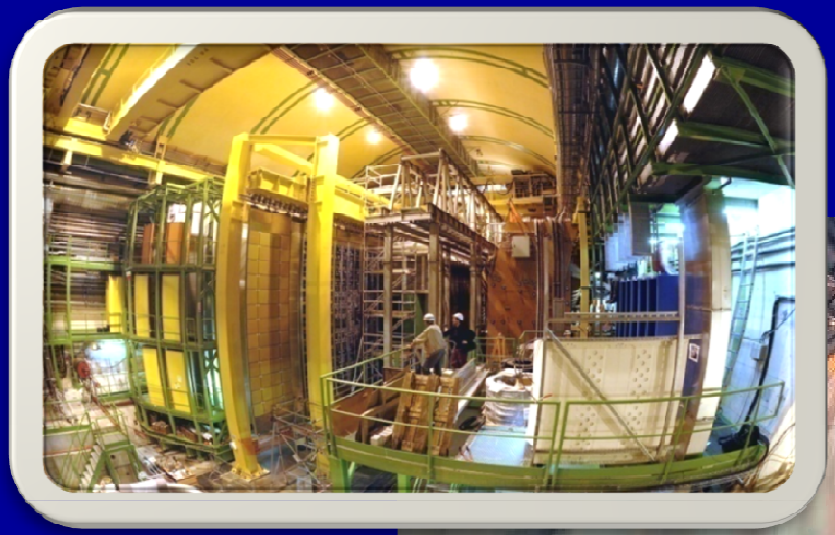
Fairouz Malek (Scientific Project leader)

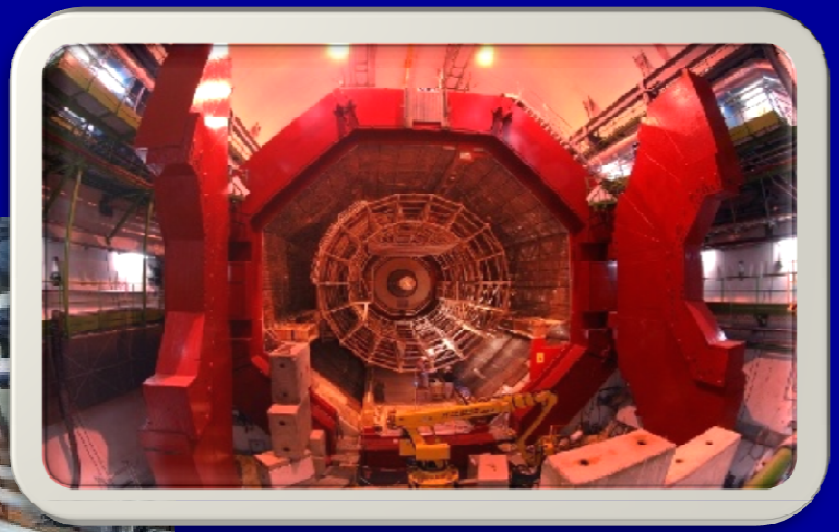
Inauguration France Grilles
Paris, September 24th, 2010

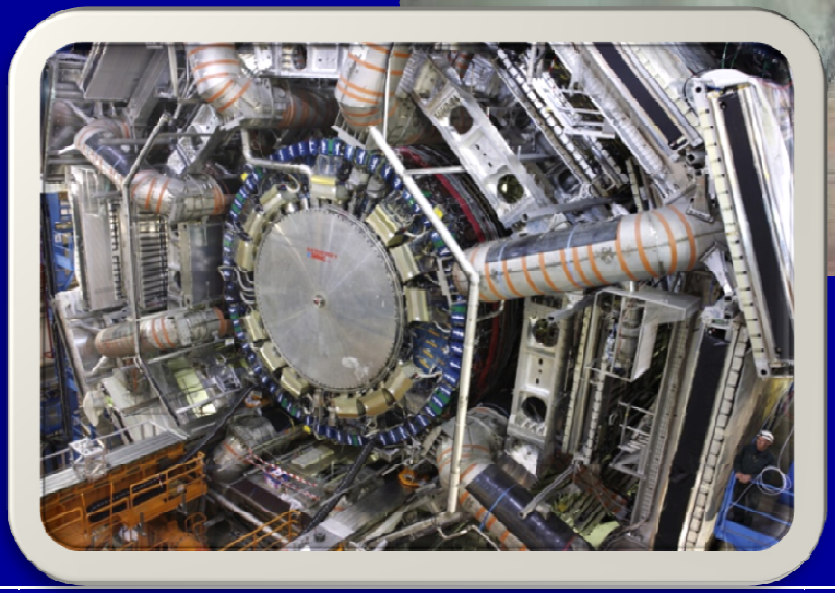
The scales

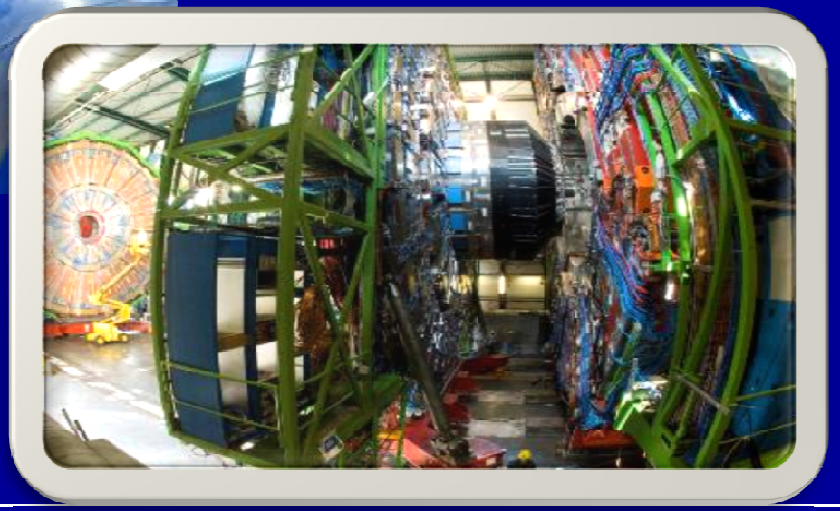

History of the Universe
Accelerators:
CERN-LHC
FNAL-Tevatron
BNL-RHIC
CERN-LEP
SLAC-SLC
high-energy cosmic rays
Inflation
BIG BANG
possible dark matter relics
cosmic microwave radiation visible
Today
Key:
quark
gluon
electron
muon
tau
neutrino
W, Z bosons
meson
baryon
ion
atom
photon
star
galaxy
black hole
(sec, yrs)
(Kelvin)
(GeV)
Particle Data Group, LBNL, © 2000.
Supported by DOE and NSF

LHC: 4 experiments
7 TeV collisions, 10^{31} particles/sec/cm^2

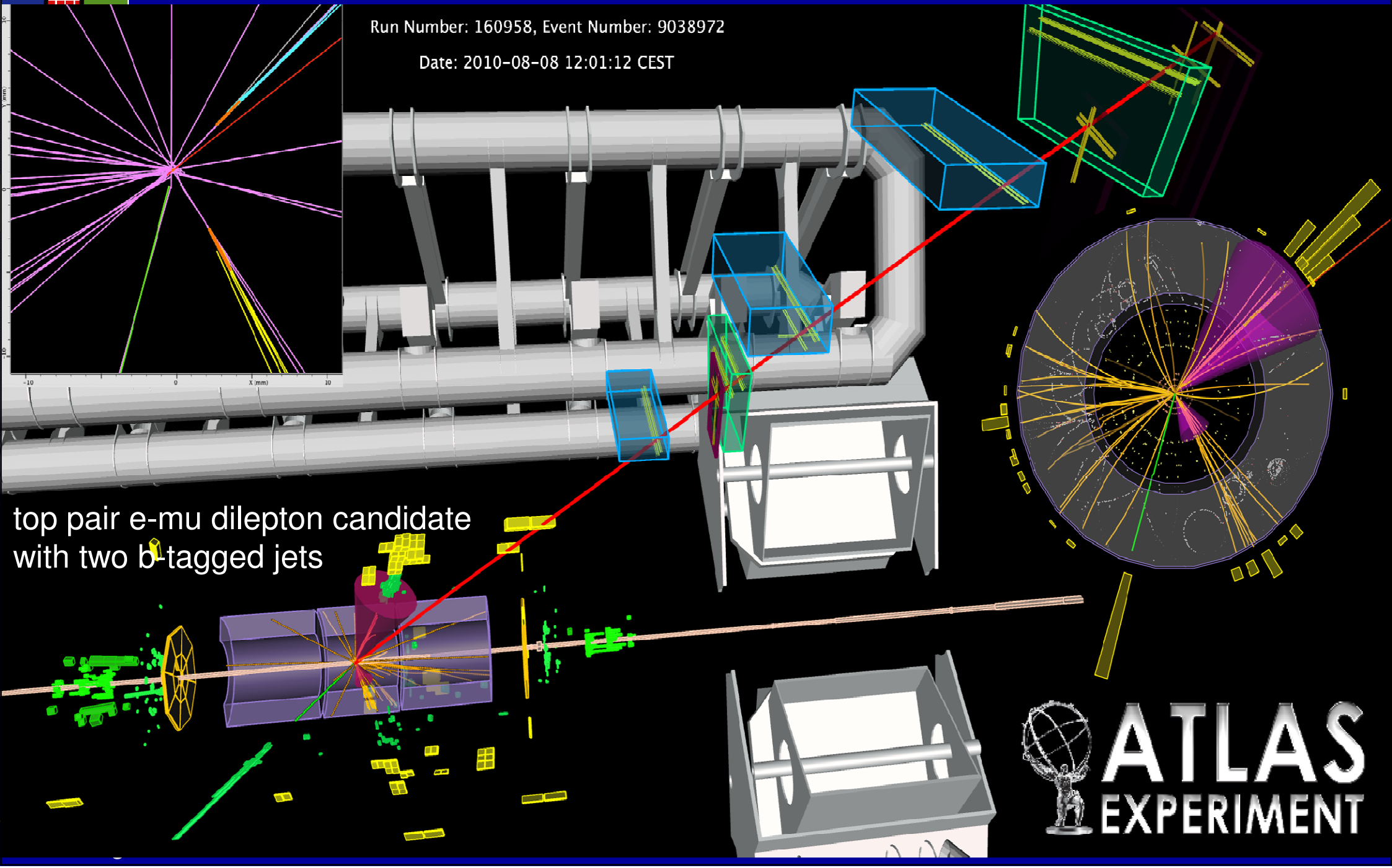








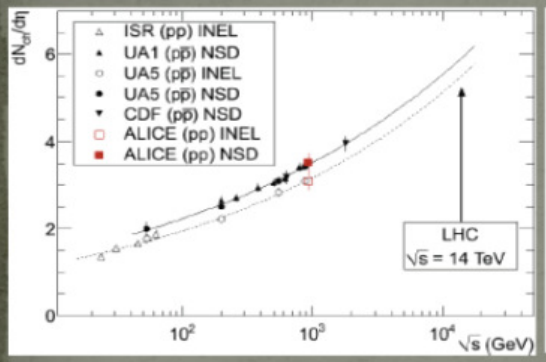
7 TeV collisions

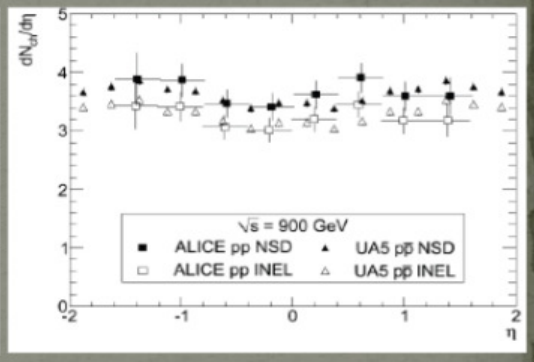


And physics output

First paper (submitted 28/11)

- $dN_{ch}/d\eta$ for $|\eta| < 0.5$
- $dN_{ch}/d\eta$ vs η

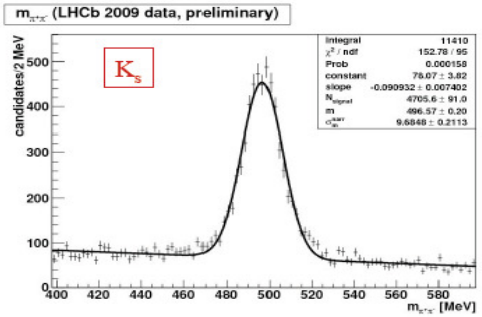


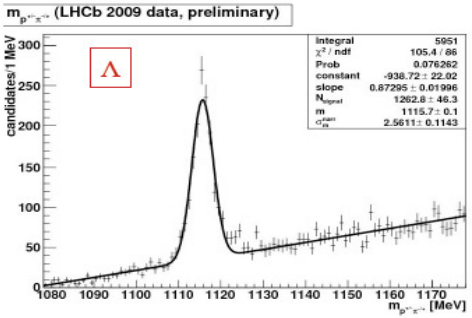


K. Aamodt et al. (ALICE), Eur. Phys. J C 65 (2010) 111

Reconstructed K_s and Λ masses

Tracking without VELO

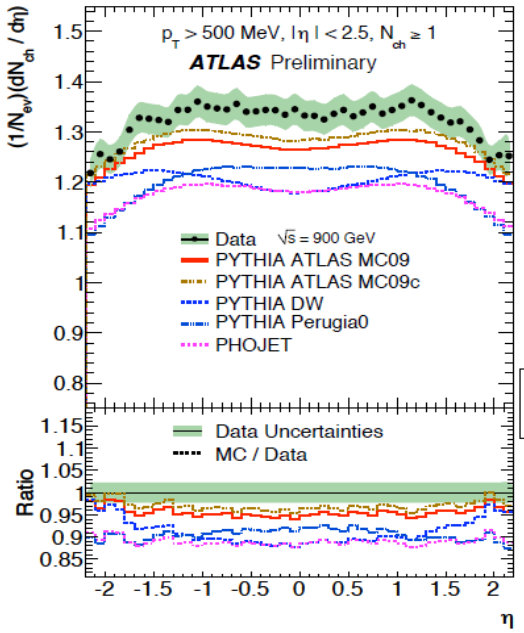




$m = (496.6 \pm 0.2_{stat.})$ MeV/c²
$\sigma = (9.7 \pm 0.2_{stat})$ MeV/c²
PDG: 497.61(2) MeV/c²

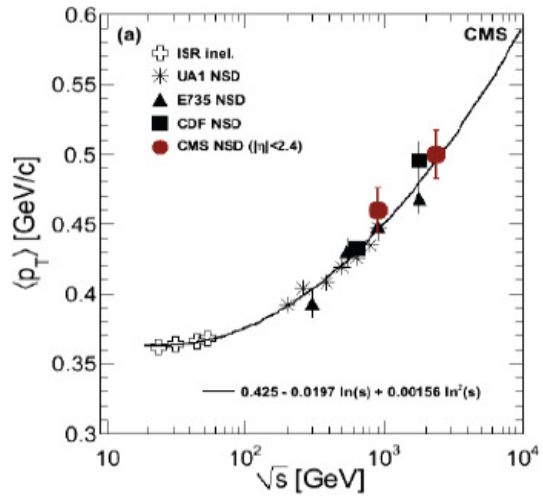
$m = (1115.7 \pm 0.1_{stat.})$ MeV/c²
$\sigma = (2.6 \pm 0.1_{stat})$ MeV/c²
PDG: 1115.683(6) MeV/c²

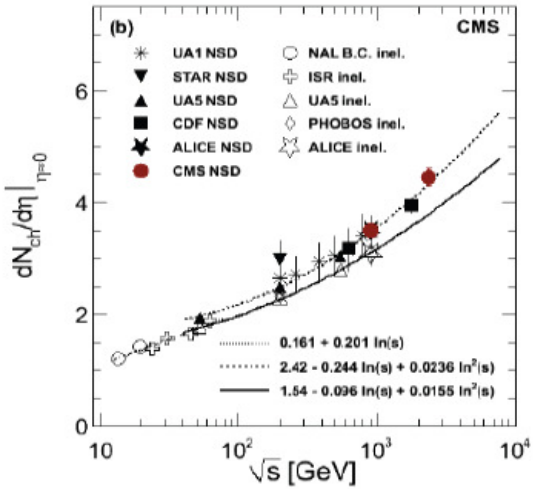
Analysis overview - Results



- dN/dη distribution
- Shape agrees well with some PYTHIA tunes
- ATLAS data shows higher value then all MCs
  - -MCs tuned in different region of phase space

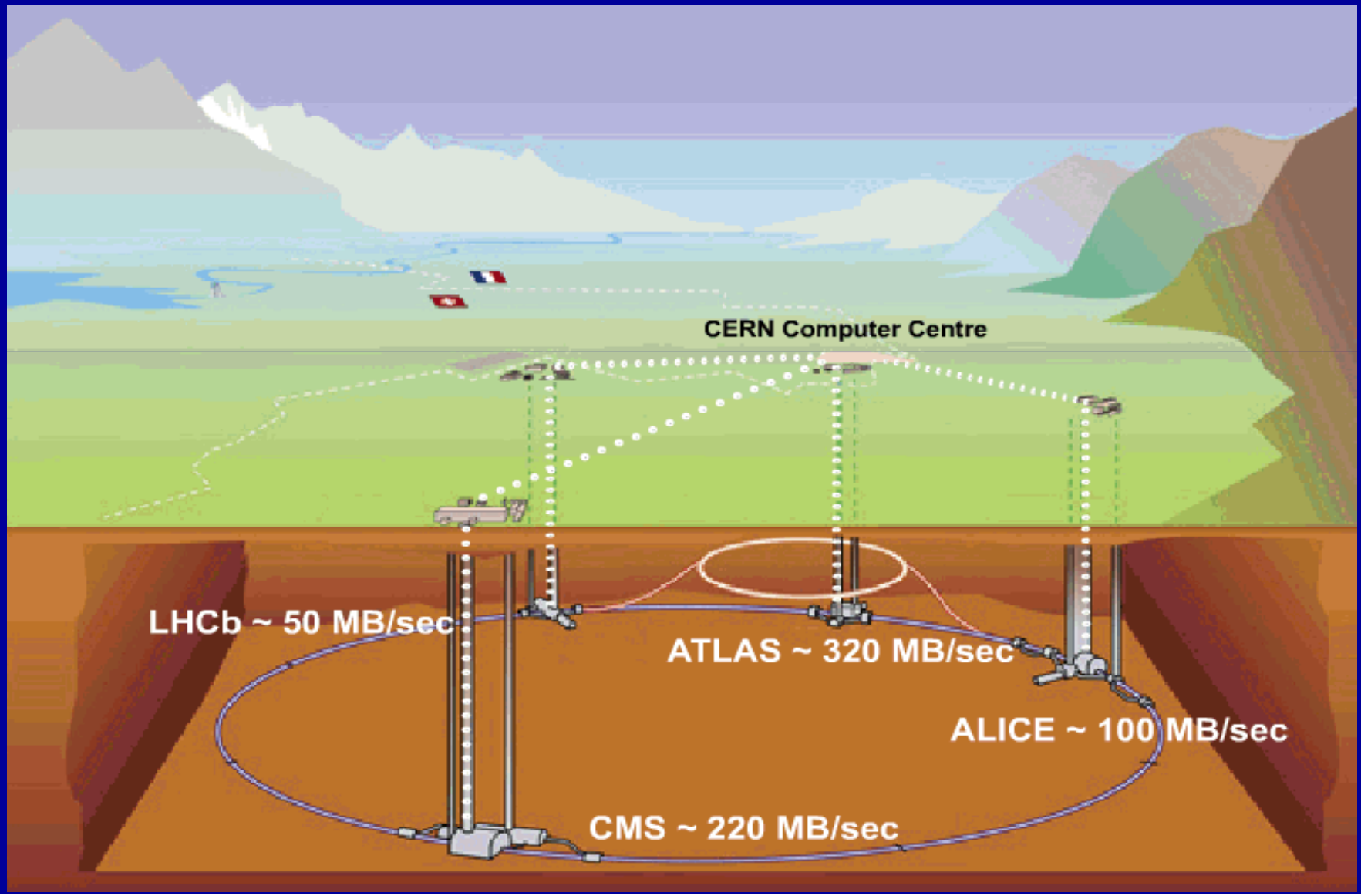
Note suppressed 0 on y-axis



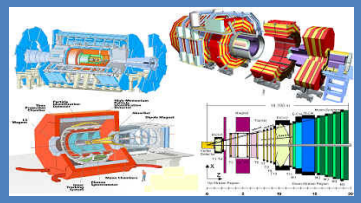


First CMS Paper on pp data
http://arxiv.org/abs/1002.0621
Accepted Feb 7 for publication in the Journal of High Energy Physics (JHEP)

@ CERN: Acquisition, First pass reconstruction, Storage Distribution



LCG System Architecture



Trigger and Data Acquisition System

Tier-0

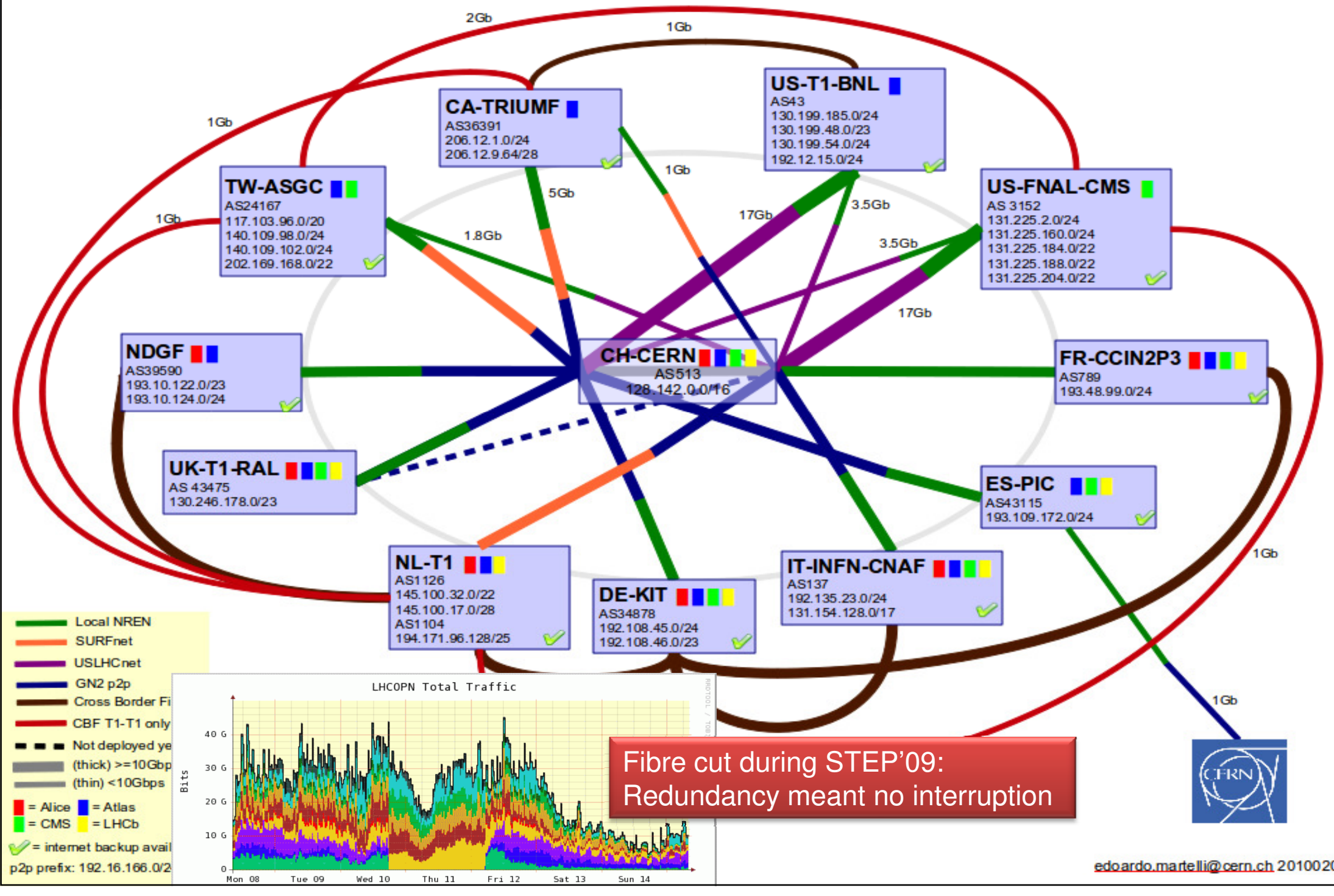
10 Gbps links
Optical Private Network (to almost all sites)

Tier-1

General Purpose/Academic/Research Network

Tier-2

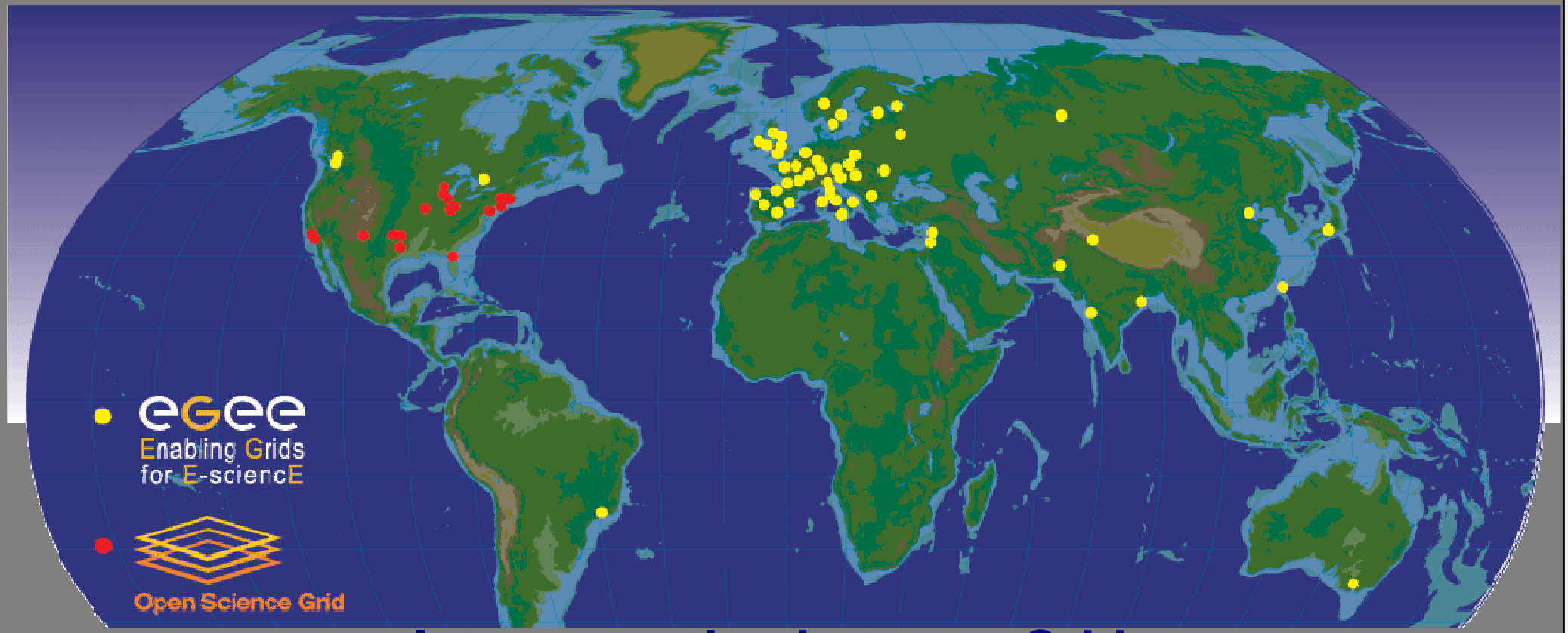
LHCOPN – current status



edoardo.martelli@cern.ch 20100205

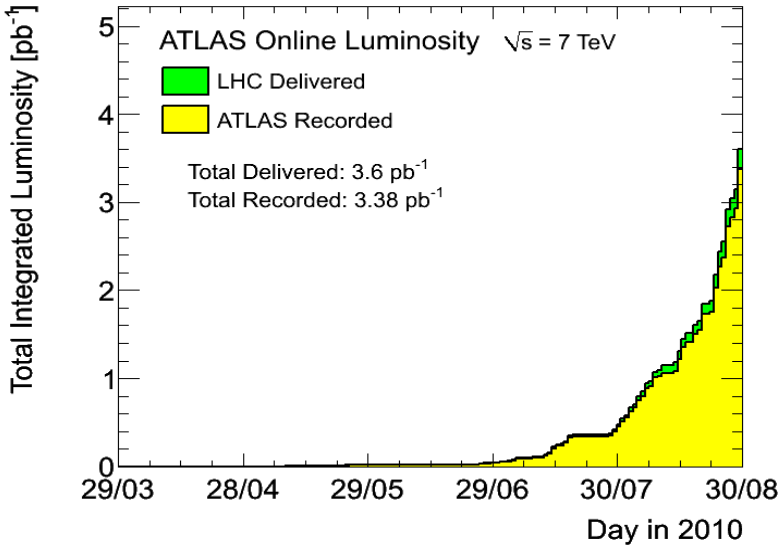
Centers around the world form a Supercomputer

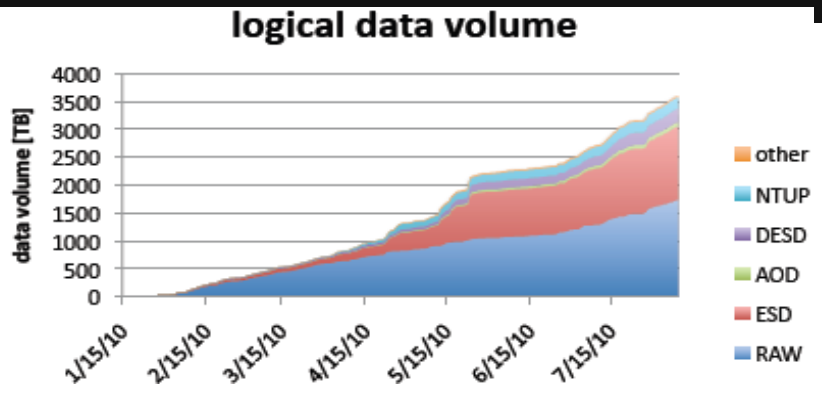
- The EGEE and OSG projects are the basis of the Worldwide LHC Computing Grid Project WLCG



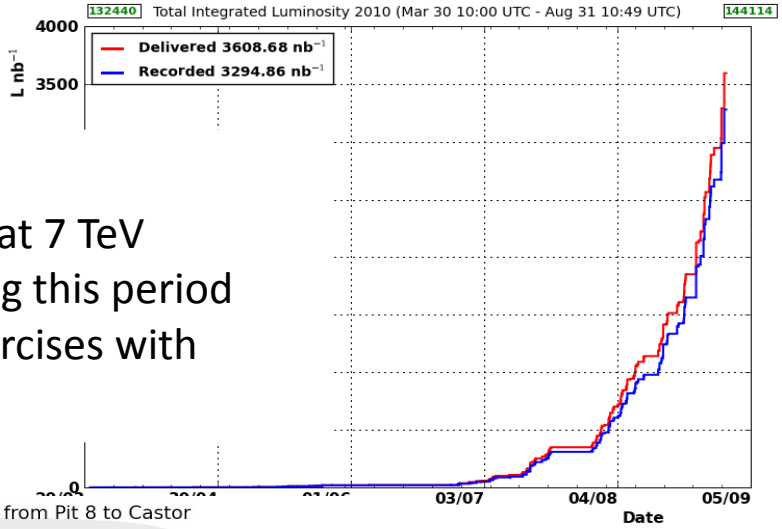
Inter-operation between Grids

5 months with LHC data

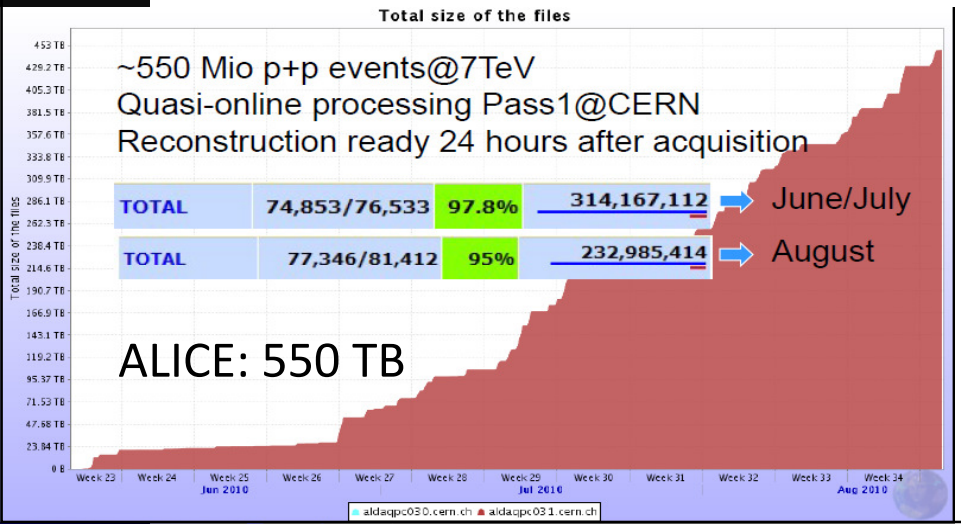


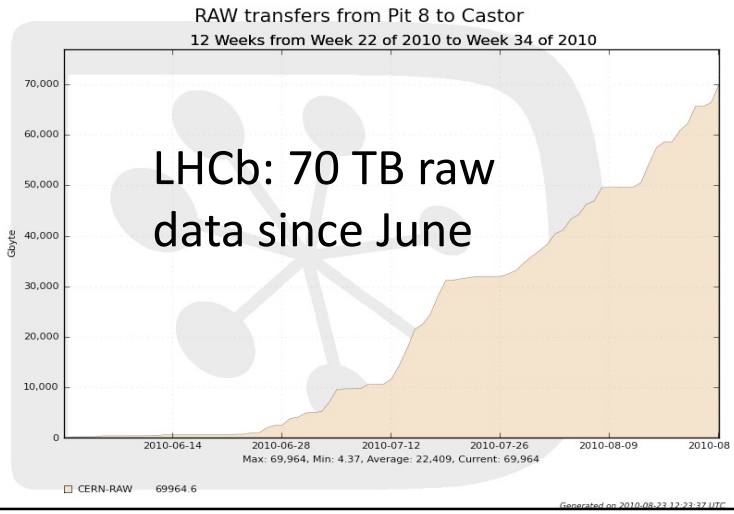


ATLAS: 1.7 PB raw



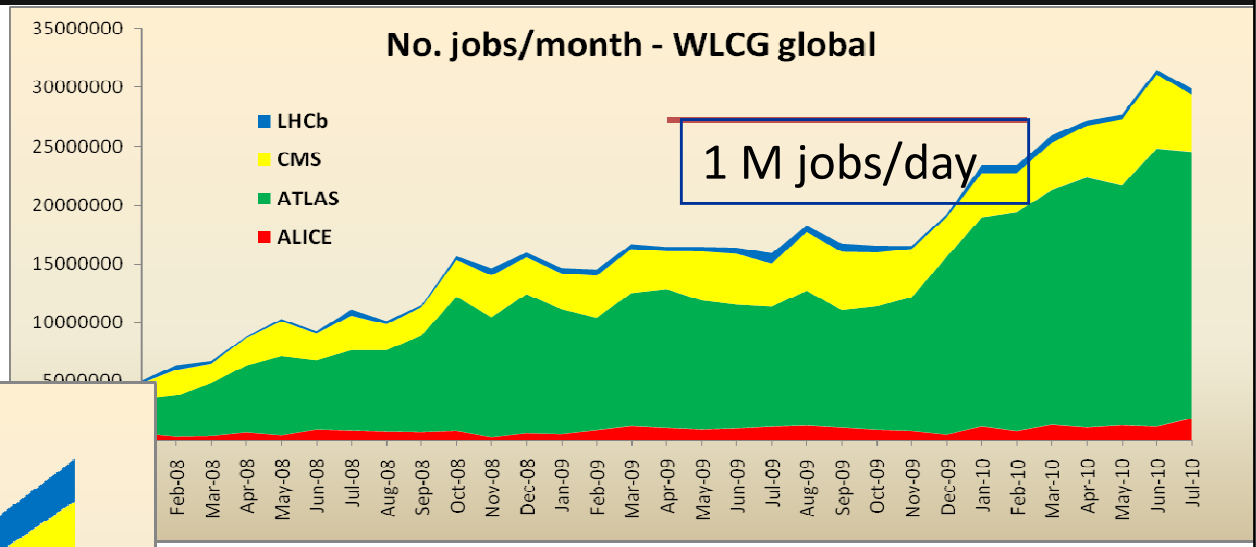
CMS:
- 220 TB of RAW data at 7 TeV
- 70 TB Cosmics during this period
- 110 TB Tests and exercises with trigger.

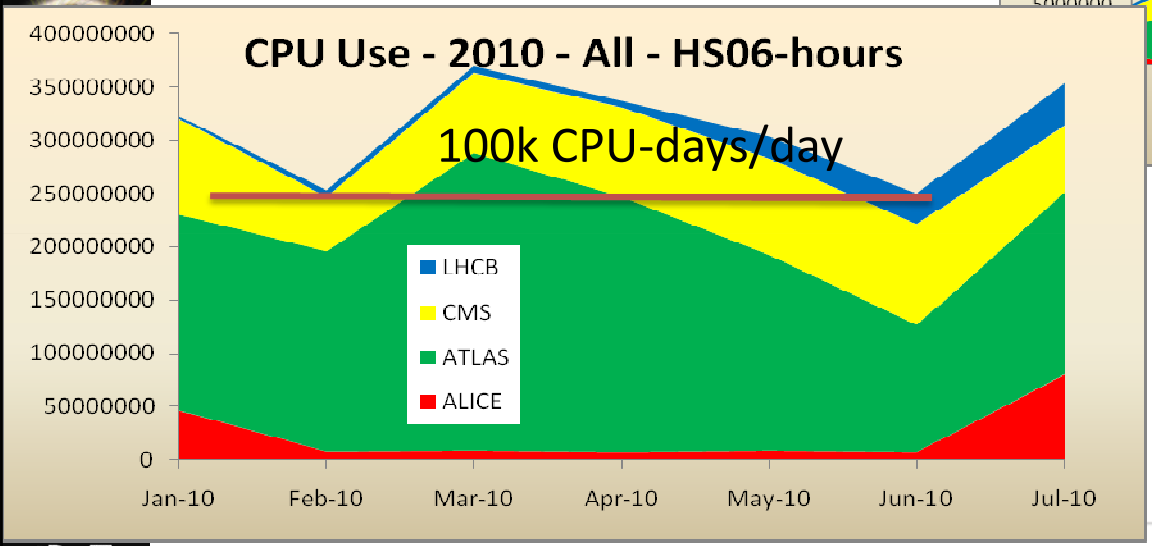


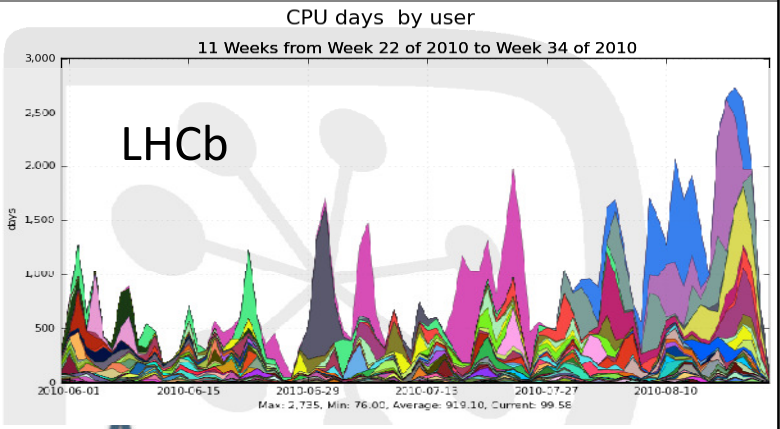


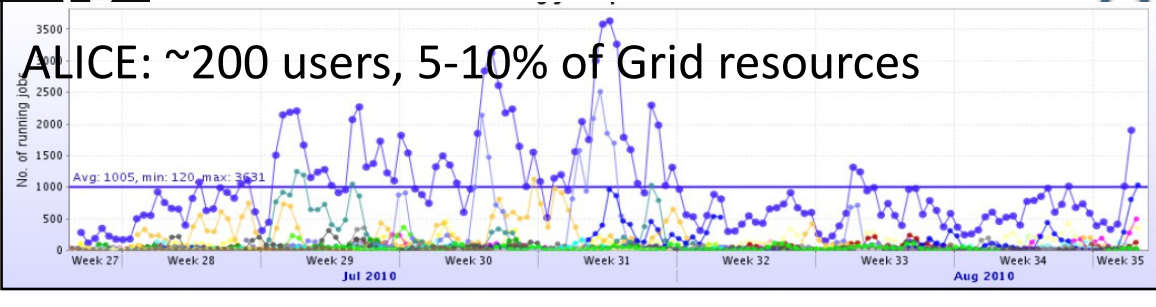
WLCG Usage

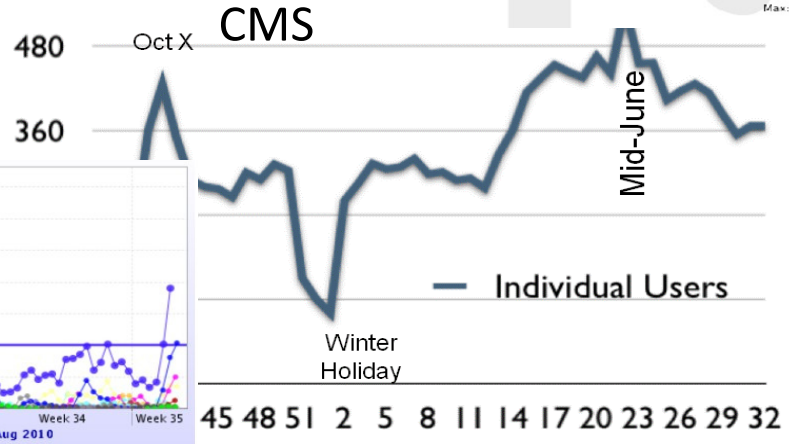
- Use remains consistently high
  - 1 M jobs/day; 100k CPU-days/day









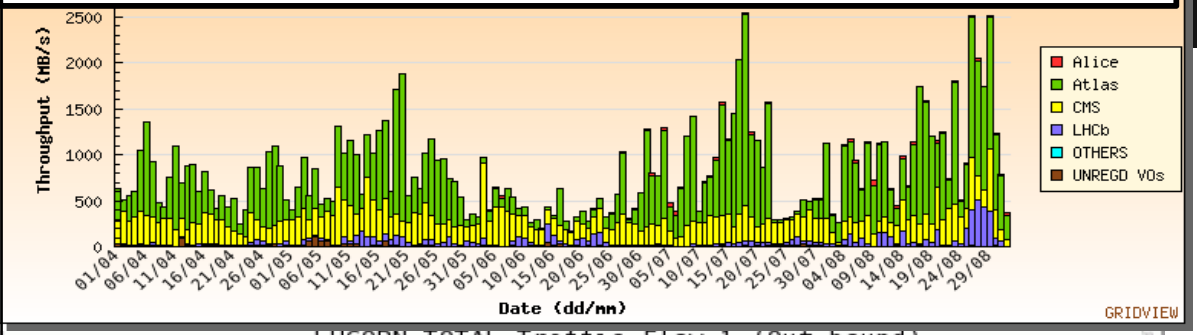


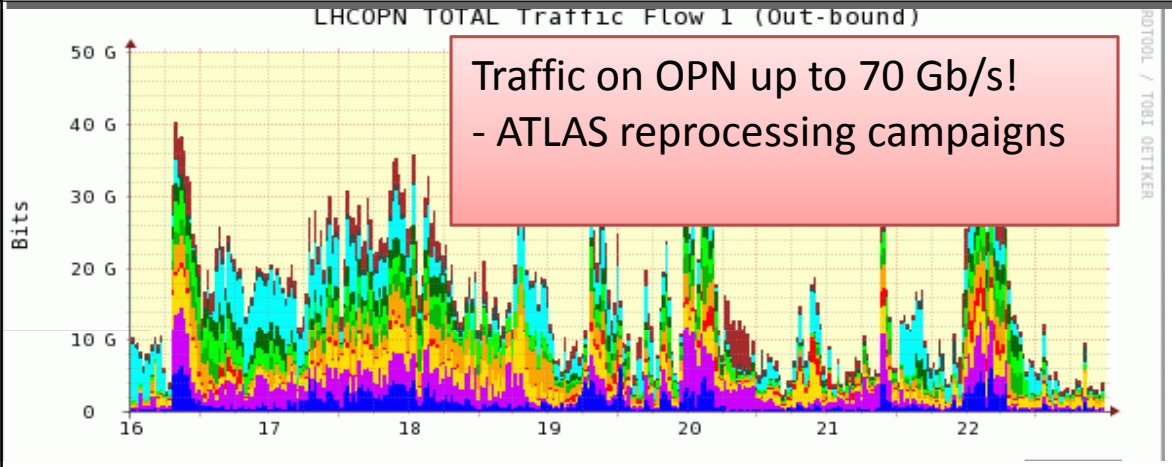
Large numbers of analysis users

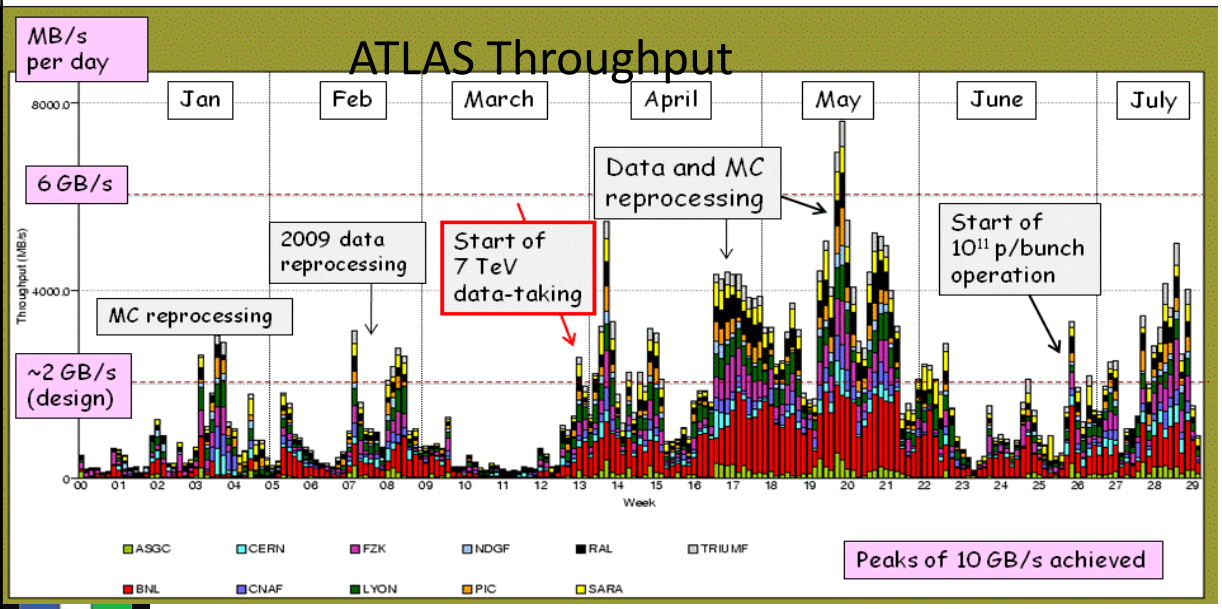
CMS ~500,
ATLAS ~1000,
LHCb/ALICE ~200

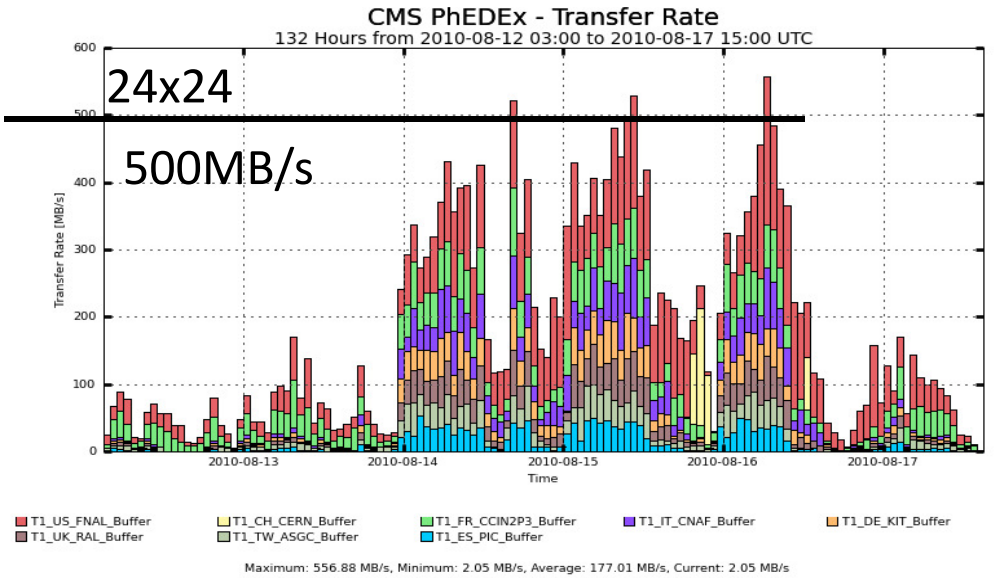
Data transfers

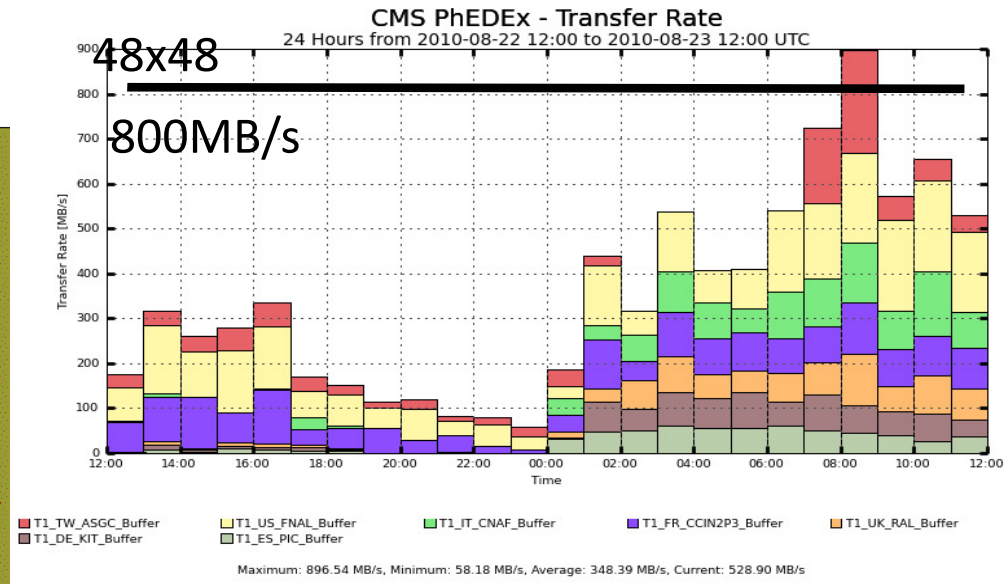
- Data transfers (mostly!) at rates anticipated







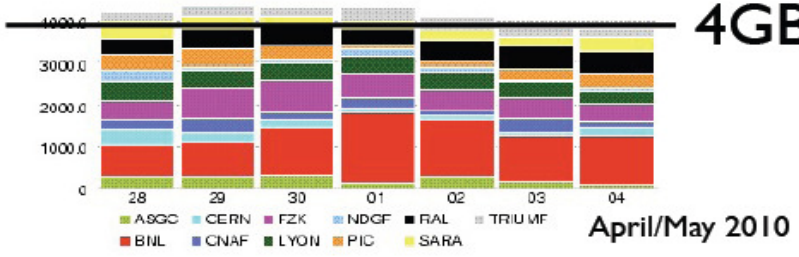




– CMS saw effect of going from 24x24 to 48x48 bunches

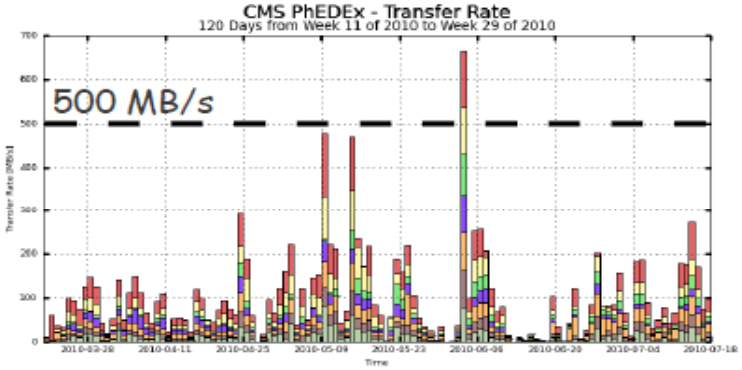
Data distribution

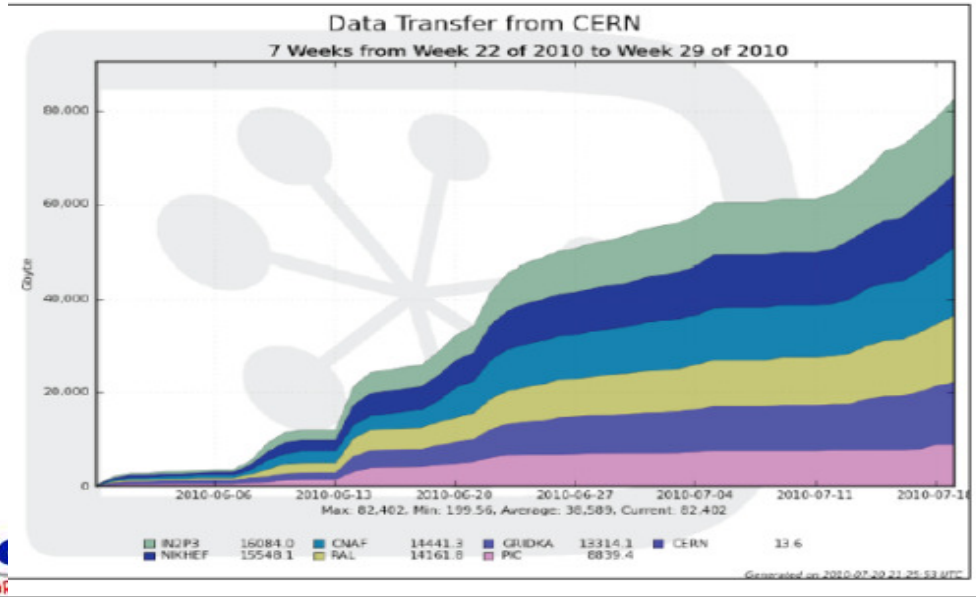
- In concert with data reprocessing we reprocess MC to assure consistency
- This leads to large volumes of data which need to be distributed after reprocessing campaigns
  - This takes a long time!
- Can lead to delays in 'interesting' data arriving



Disk Usage Ramp up an T1s

- Resources provisioned for steady data stream from Tier-0 to Tier-1's
- Current reality looks different
- Total volume of 1 PB since April
- Very good transfer quality





- RAW Data is replicated to one of the Tier-1
- Albeit some initial problem, data is now successfully transferred on regular basis.

ATLAS: Total throughput T0-T1; T1-T1; T1-T2

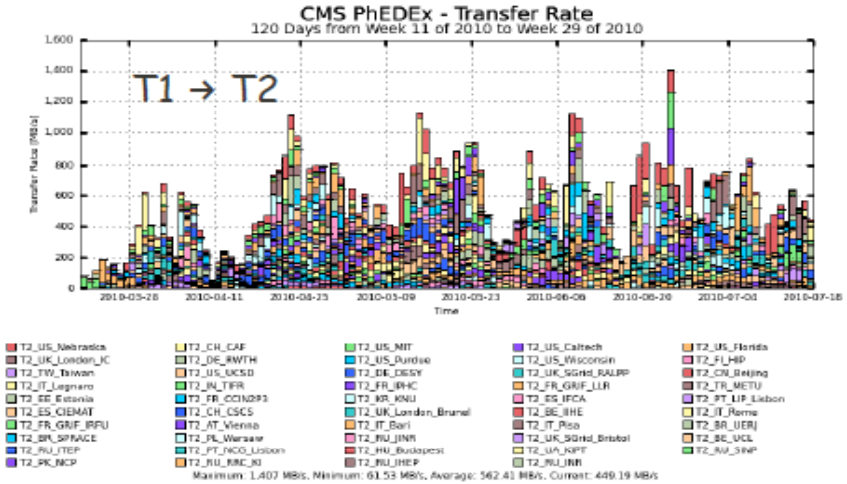
CMS: T0 – T1

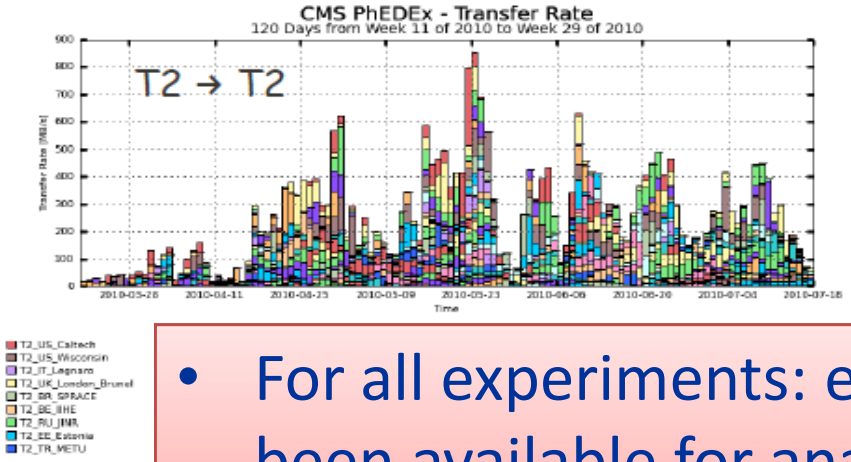
LHCb: T0 – T1

Data distribution for analysis

Data Distribution for Analysis

- Data transferred from Tier-1's
  - 49 Tier-2 sites received data
  - > 5 PB transferred in last 120 days
  - average rate 562 MB/s
  - max rate 1407 MB/s
- Data transferred between Tier-2's
  - 41 Tier-2 sites received data
  - > 2.5 PB transferred in last 120 days
  - average rate 254 MB/s
  - max rate 853 MB /s
  - full mesh approach
  - Data distribution re-balances itself
  - Datasets produced at Tier-2's can be distributed to others

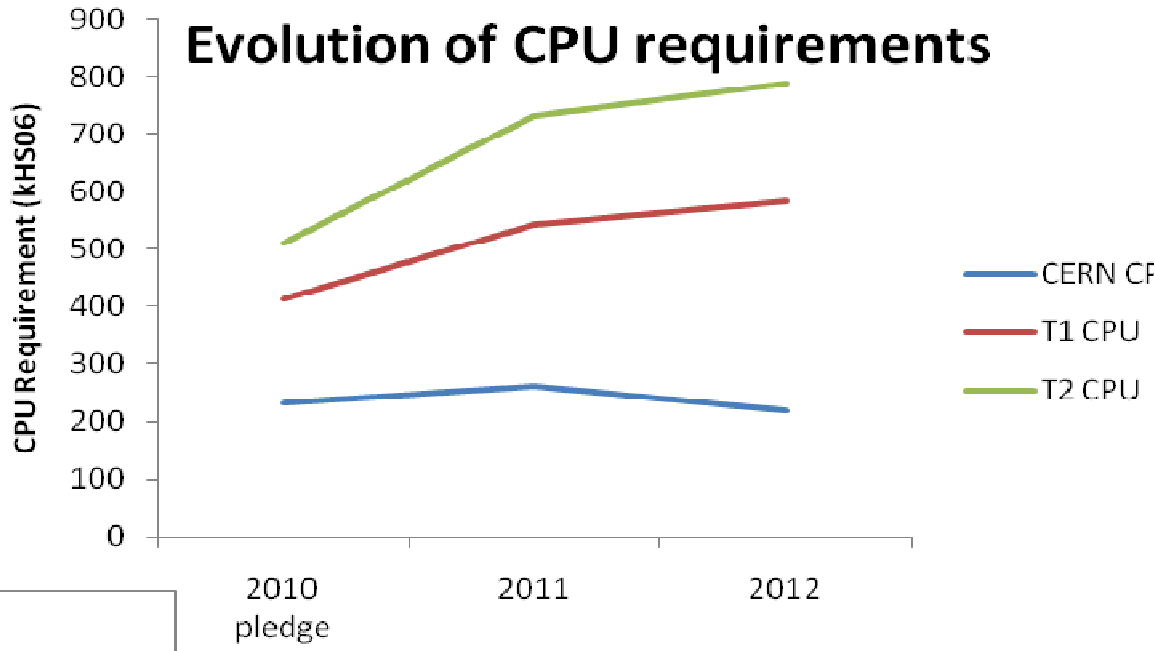


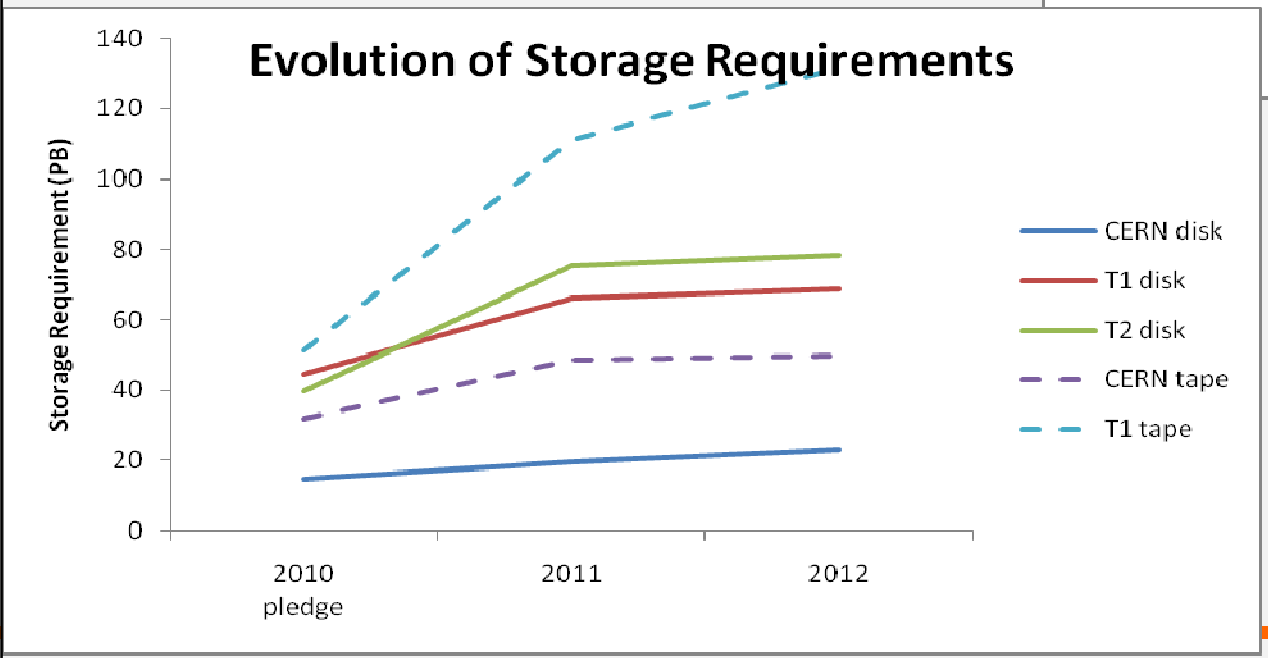


- For all experiments: early data has been available for analysis within hours of data taking

Summary of requirements

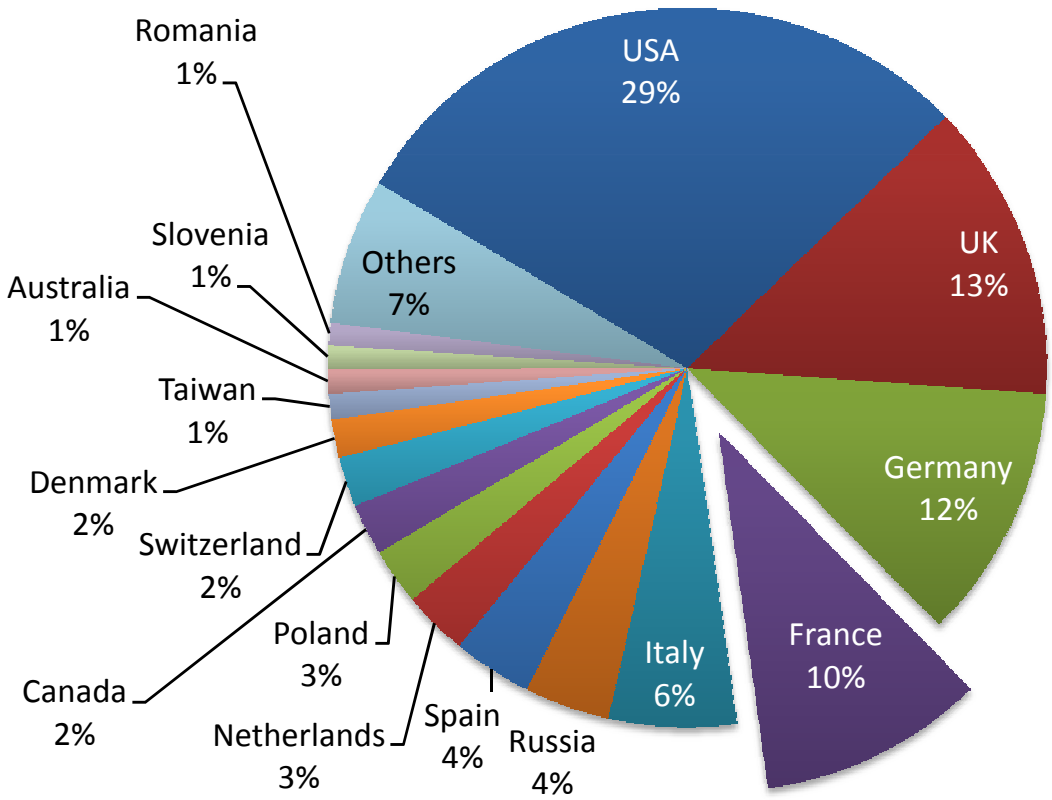
@C-RRB, April 2010





LCG-France within WLCG

CPU Contribution per Country



Contribution to the WLCG collaboration is in line with LCG-France's target.

46 countries contributed CPU ressources to the 4 LHC experiments in 2009

Source: EGEE Accounting Portal https://www3.egee.cesga.es/gridsite/accounting/CESGA/country_view.html

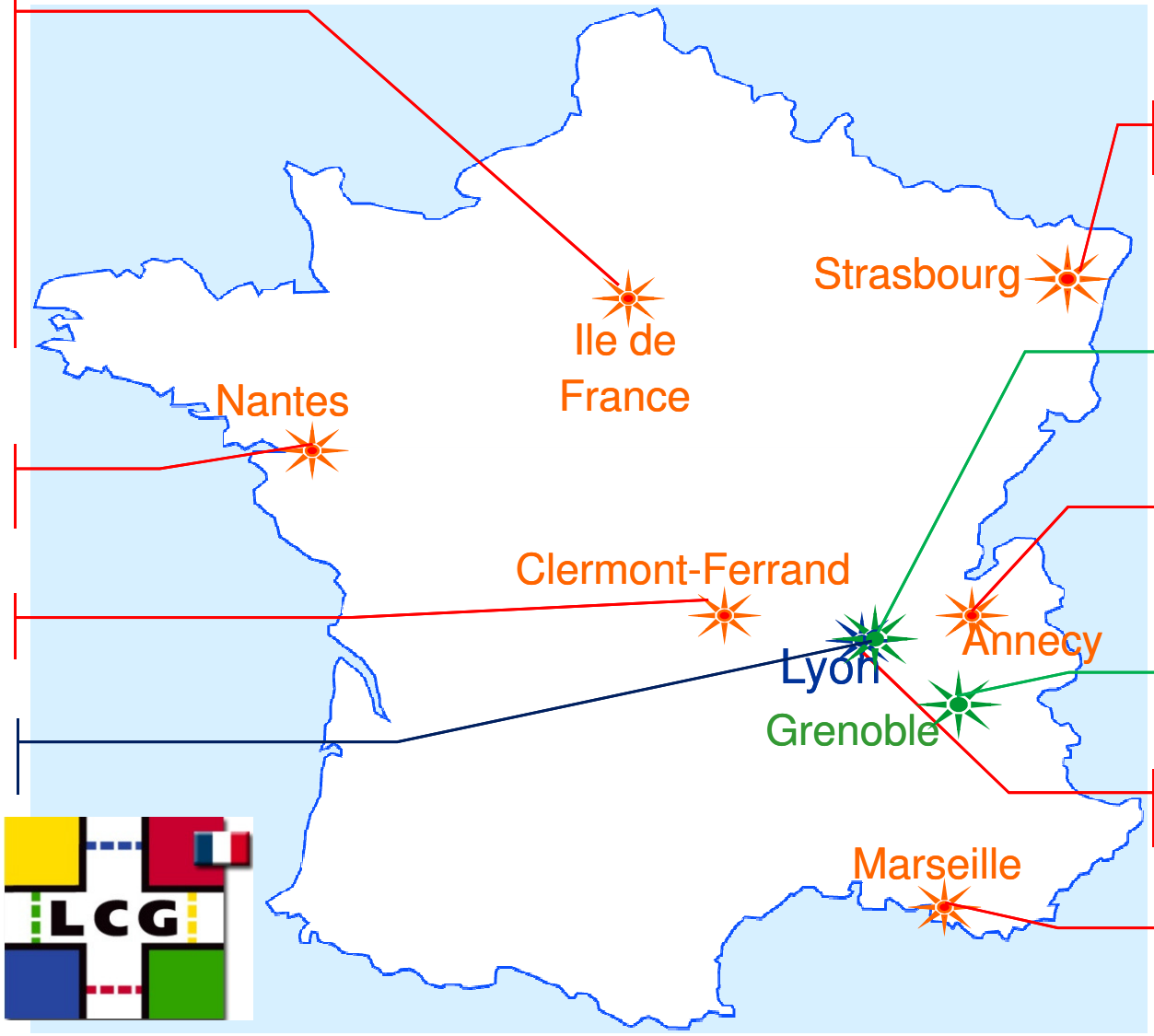
Sites LCG-France

Tier-2: GRIF
•CEA/IRFU
•LAL
•LLR
•LPNHE
•IPNO

Tier-2: Subatech

Tier-2: LPC

Tier-1: CC-IN2P3



Tier-2: IPHC

Tier-3: IPNL

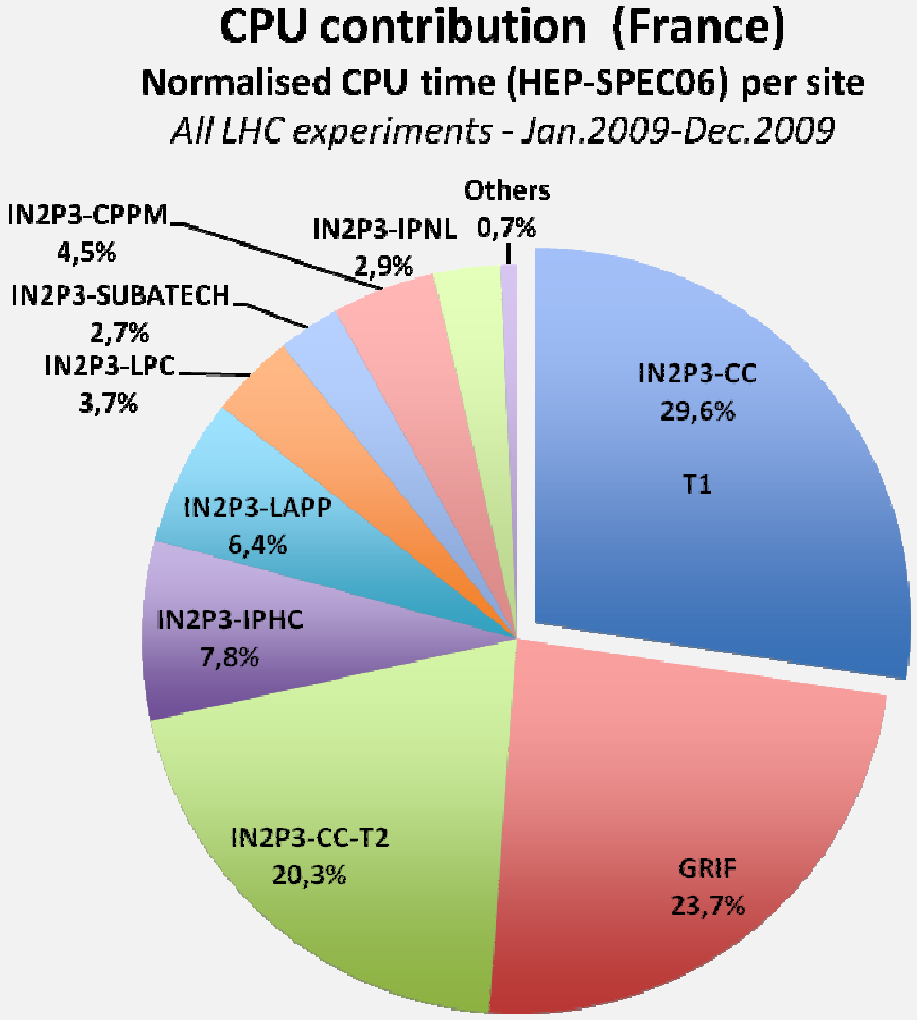
Tier-2: LAPP

Tier-3: LPSC

AF: CC-IN2P3

Tier-2: CPPM

LCG-France – CPU Contribution per Site



Source: EGEE Accounting Portal
https://www3.egee.cesga.es/gridsite/accounting/CESGA/country_view.html

70% of the CPU time is used in tier-2s, including the one co-located with the tier-1.

50% of CPU time used outside CC-IN2P3. ~same leel as in previous years.

EGI Availability and Reliability Report
NGI FRANCE

Region	Site	Phy. CPU	Log. CPU	HS06	Availability	Reliability	Unknown	Availability History Apr-10	May-10	Jun-10
NGI_FRANCE (NGI_FRANCE)										
	AUVERGRID	372	372	27,016	94 %	100 %	1 %	99 %	96 %	89 %
	CGG-LCG2	140	140	N/A	100 %	100 %	0 %	85 %	99 %	96 %
	GRIF	1,360	5,654	15,668	100 %	100 %	0 %	100 %	100 %	95 %
	IBCP-GBIO	138	494	954	97 %	97 %	1 %	99 %	100 %	100 %
	IN2P3-CC	1,143	4,572	39,438	100 %	100 %	0 %	95 %	100 %	99 %
	IN2P3 CC T2	1,681	7,448	35,478	100 %	100 %	0 %	95 %	89 %	99 %
	IN2P3-CPPM	158	469	3,752	100 %	100 %	0 %	97 %	99 %	92 %
	IN2P3-IPNL	168	672	5,527	96 %	96 %	0 %	99 %	100 %	98 %
	IN2P3-IRES	256	1,216	10,944	100 %	100 %	0 %	91 %	93 %	99 %
	IN2P3-LAPP	220	752	7,391	100 %	100 %	0 %	97 %	99 %	95 %
	IN2P3-LPC	452	1,824	14,424	71 %	92 %	0 %	99 %	91 %	100 %
	IN2P3-LPSC	162	540	4,417	97 %	99 %	0 %	98 %	93 %	97 %
	IN2P3-SUBATECH	104	408	3,487	95 %	100 %	0 %	99 %	98 %	99 %
	IPSL-IPGP-LCG2	34	34	N/A	63 %	63 %	0 %	90 %	94 %	81 %
	M3PEC	20	112	896	91 %	95 %	0 %	99 %	98 %	99 %
	MSFG OPEN	26	104	822	99 %	100 %	0 %	90 %	98 %	91 %
	OBSPM	32	112	112	98 %	98 %	21 %	0 %	0 %	70 %

LCG-France sites

Perspectives

- We have entered the operational phase of the WLCG infrastructure: yet a « real » experience!
- Data distribution and most data processing activities on the grid platform are understood and have been routinely exercised
- LCG-France has contributed to create a community of IN2P3 & Irfu people deeply involved in processing the data and on the daily operations: **The French contribution to the worldwide LCG community is undoubtely visible**

Credits to

- **WLCG inputs (C-RRB, Overview board, LCG office)**
- **LCG-France sites inputs**
- **Pierre Girard, CCin2p3**
- **Frédérique Chollet, LCG-France Technical manager**