



LHC Software: Crunch Time!

**Introduction to the
Workshop**

NSS/IEEE October 26, 2005

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Introduction to the Workshop



- LHC experimental goals and timeline
- LHC software requirements
- Commonalities in software and computing systems
 - ROOT, Gaudi and the LGC project
- Questions to the panel and the audience



LHC Goals and Timeline



- pp collider:
 - 7+7 TeV beams @ $10^{34} \text{ cm}^{-2} \text{ s}^{-1}$
 - EW Symmetry Breaking (Higgs)
 - Physics beyond SM (SUSY)
 - Precision SM physics (CKM, Origin of CP Violation, new physics)
- Pb-Pb collider:
 - 2.8 TeV/nucleon @ $10^{27} \text{ cm}^{-2} \text{ s}^{-1}$
 - 1.15 PeV CM
 - Quark-gluon plasma

Dec 94 LHC Approved

Two stages 2004/2008

Oct 95 Concept Design

Dec 96 Single Stage Design

Jun 03 Atlas Cavern ready

Feb 05 CMS Cavern ready

2005/06 Commissioning

Summer 07: Pilot Run

$10^{30} - 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$

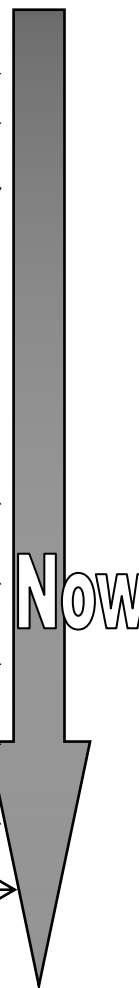
Summer 08: Initial Luminosity

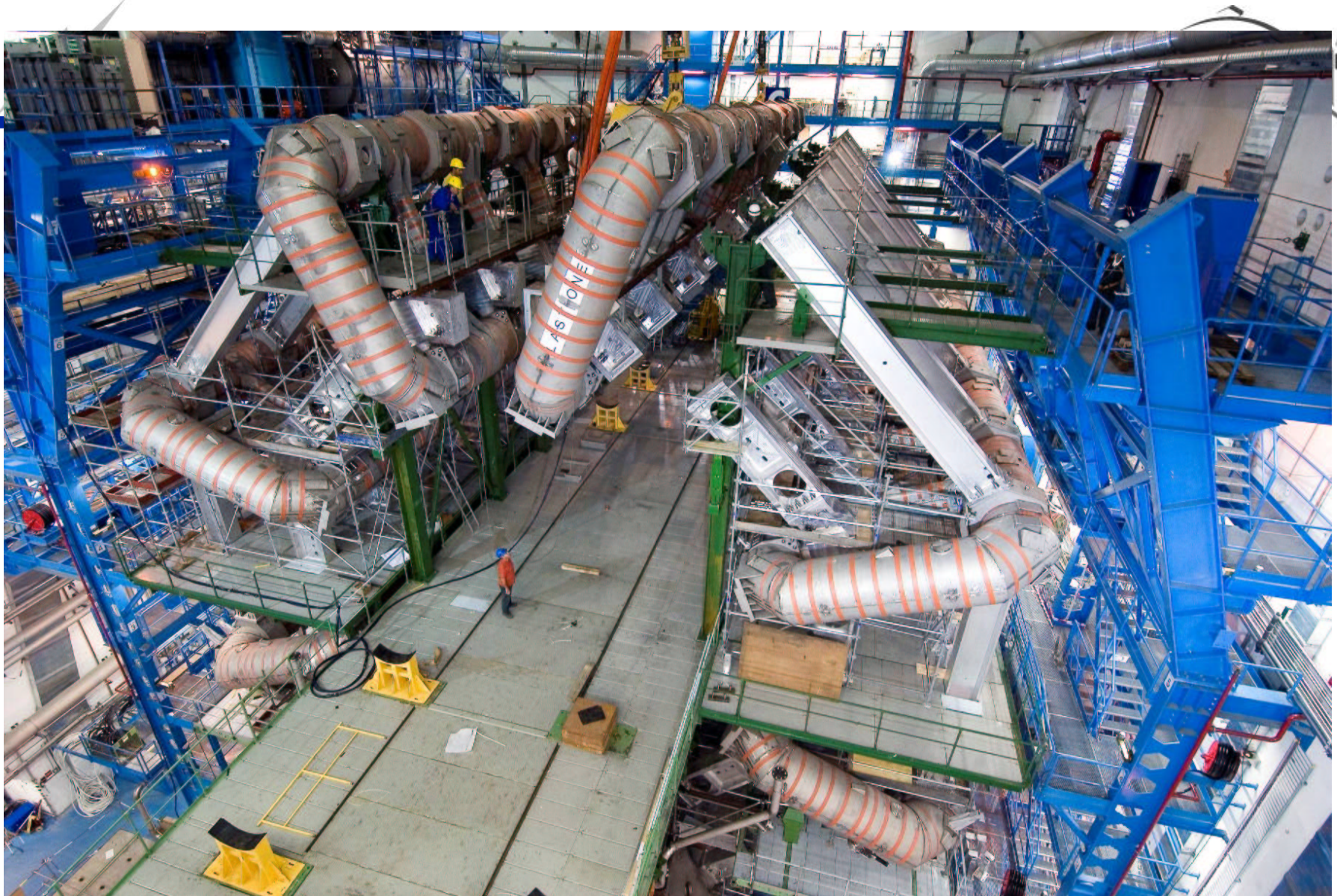
$2 \times 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$

Summer 09: Design Luminosity

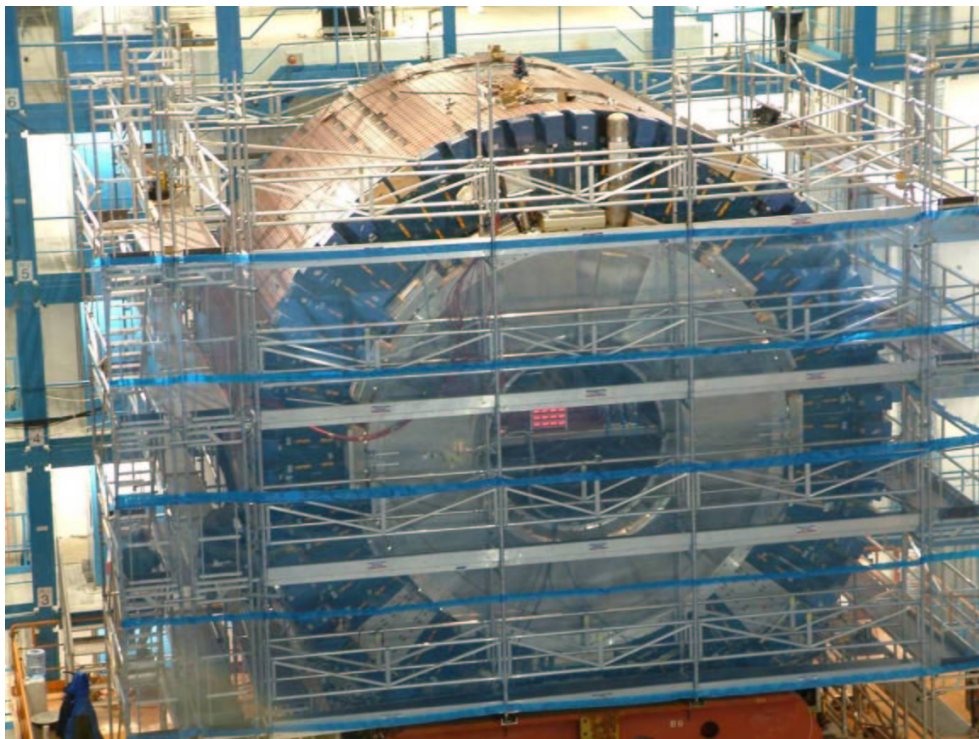
$10^{34} \text{ cm}^{-2} \text{ s}^{-1}$

Now

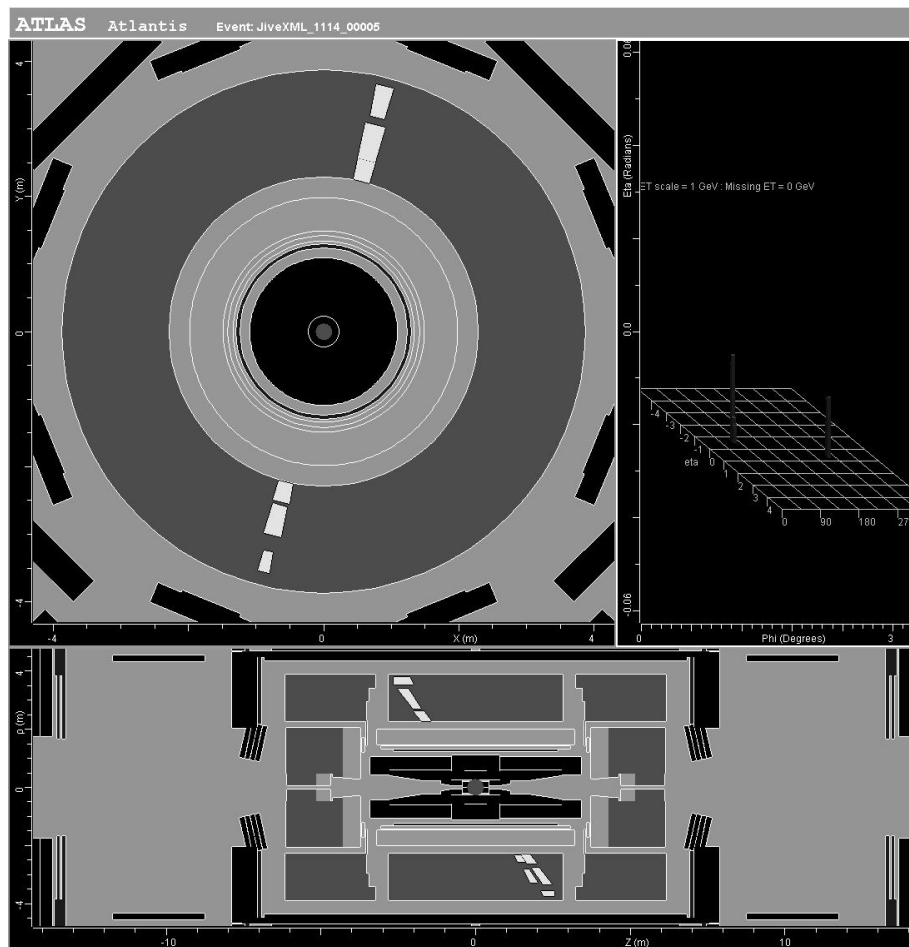




The last ATLAS Barrel Toroid coil was moved into position on 25th August and the structure was released from the external supports on 29th September



A cosmic muon registered in the ATLAS barrel Tile calorimeter



The ATLAS barrel LAr and Tile calorimeters are ready since some time in the cavern in their 'garage Position' to be moved into their final position at the end of October.



LHC Software Environment



- Unprecedented experimental conditions
 - Energy Range (~ 0.1 -1000 GeV particles)
 - Particle multiplicity
 - CMS/ATLAS will record ~ 20 pp/bunch xing (event)
 - ALICE will see $\sim 10^4$ tracks/evt (40% occupancy)
 - Detector complexity ($\sim 10^8$ channels)
 - Detector precision ($< 10^{-5}$ dx/x Atlas muons)
 - DAQ/HLT rates
 - LHCb software trigger: 10^4 rejection factor
 - ALICE Pb+Pb: 1.25 GB/s to tape
- Unprecedented project scale
 - 1000+ collaborators, 30+ year, 75+ core developers



LHC Software Environment



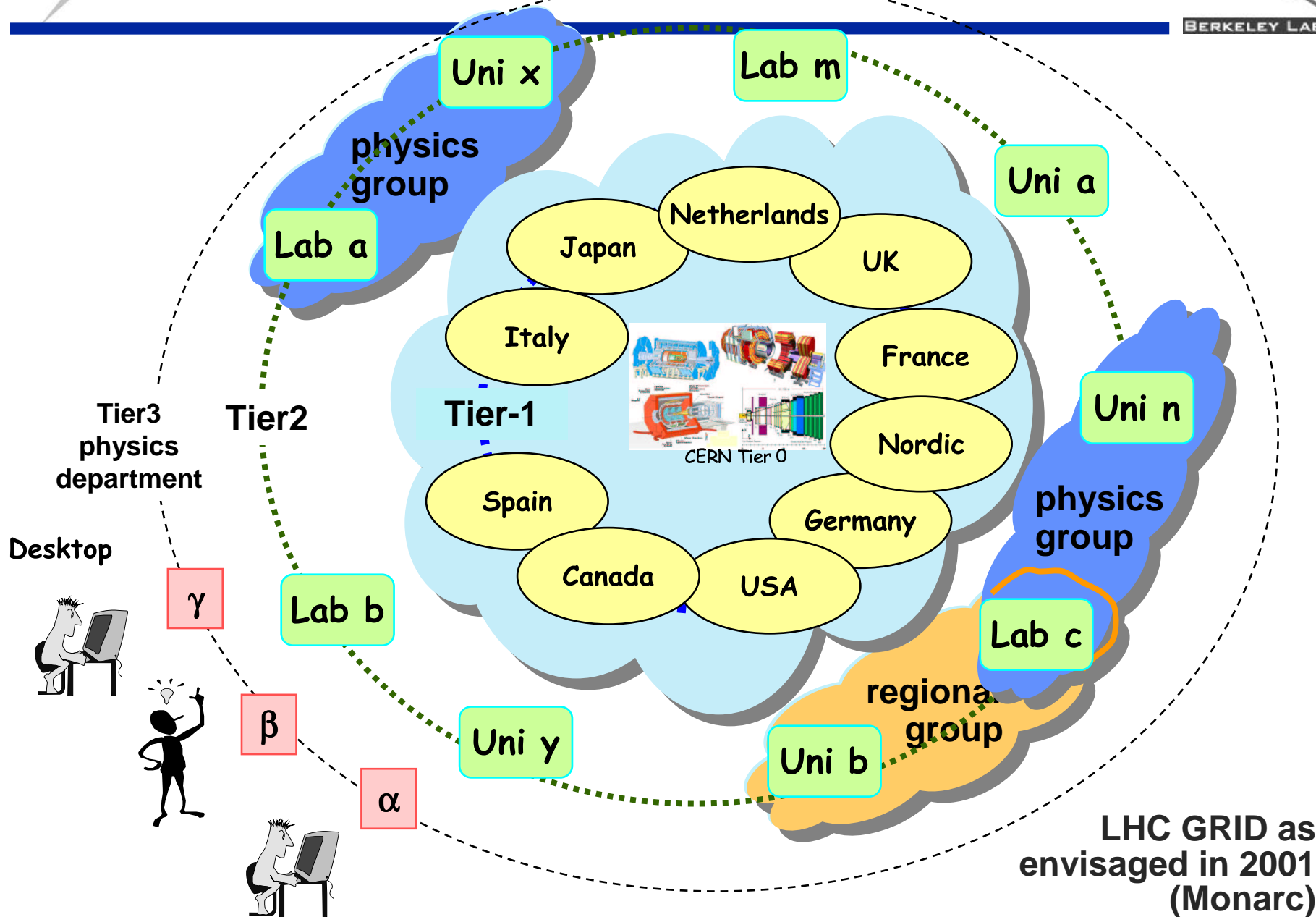
- C++ based
 - + python job configuration and interactivity
 - + some java (evt display), some fortran
- ROOT core libs (I/O, reflection, Math, python bindings, plugin management)
 - + CLHEP, Boost
 - + Gaudi control framework and component model
- POOL persistency framework
- COOL RDBMS access layer
- Simulation tools
 - Genser & Geant 4 (+ Geant 3,Fluka,...)



LHC Computing Environment

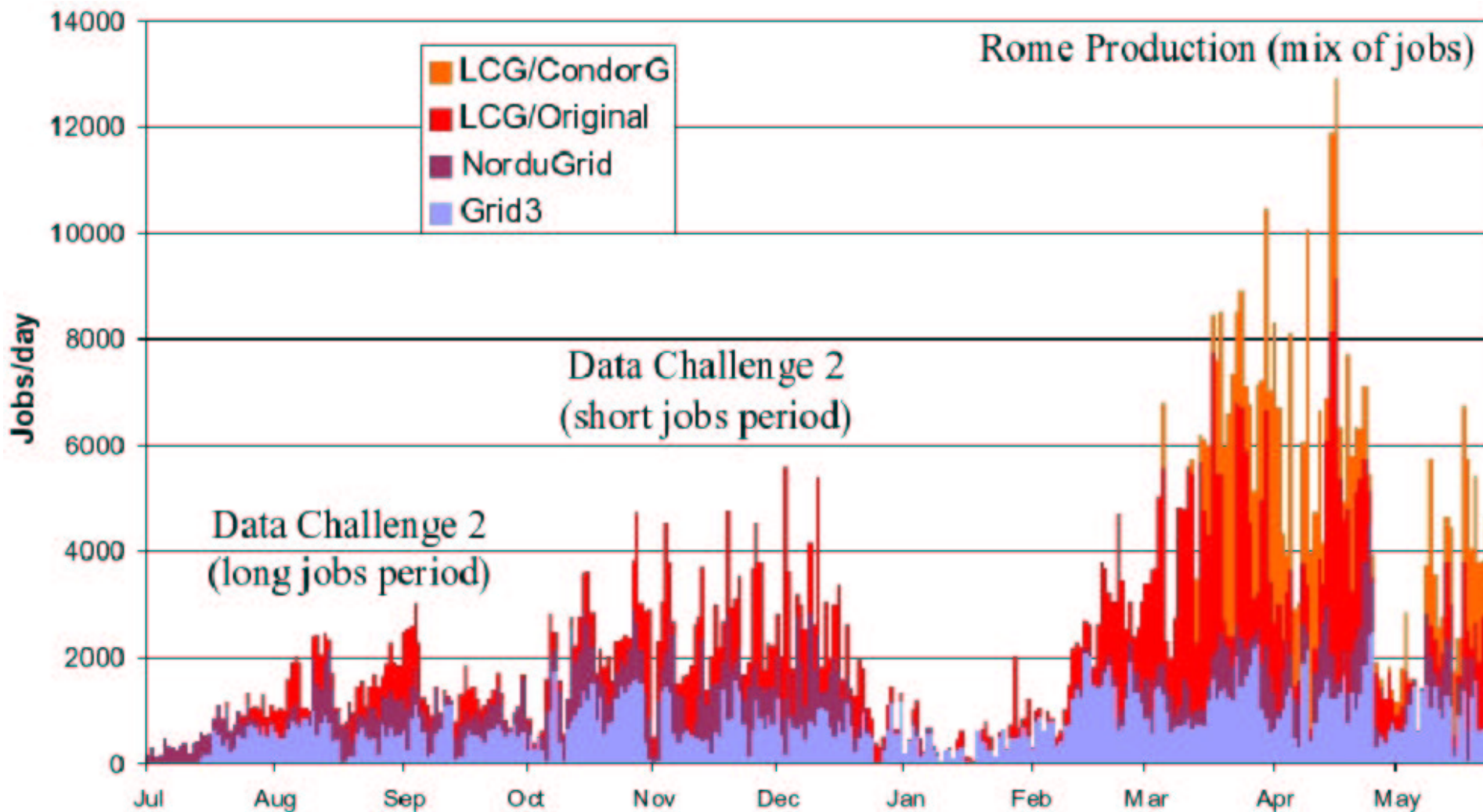


- Distributed Computing paradigm
- Multi-tier system (Monarc)
 - Tier 0 Distribute and put on tape RAW data
 - Tier 1 Scheduled Productions, RAW data backup
 - Tier 2 Group Analysis, Simulation, Calibration?
- Use/Build on Grid middleware experiment specific
 - Distributed Data Management
 - Resource management
 - Job scheduling
- Distributed Analysis
 - ARDA, PROOF, xrootd





First successful use of the GRID by a large user community in ATLAS





Some Open Questions



Is the OO simulation, reconstruction & analysis software ready?

- Do physicists find the software usable?
- Can the software be used to understand and debug the detector during commissioning?

How successful has the model of shared software development been?

- Is the effort put in common projects like Geant 4, ROOT/SEAL, Gaudi, or POOL paying off?



More Open Questions



Will the new GRID-centric distributed computing systems be deployed in time?

- How are the assumptions in the experiments computing models being tested?
- Are there contingency plans if they turn out to be too optimistic?

Offline software is being used online e.g. for the High Level Trigger.

- How well are the two cultures interacting?
- Are online requirements of performance, stability and limited external dependencies satisfied?

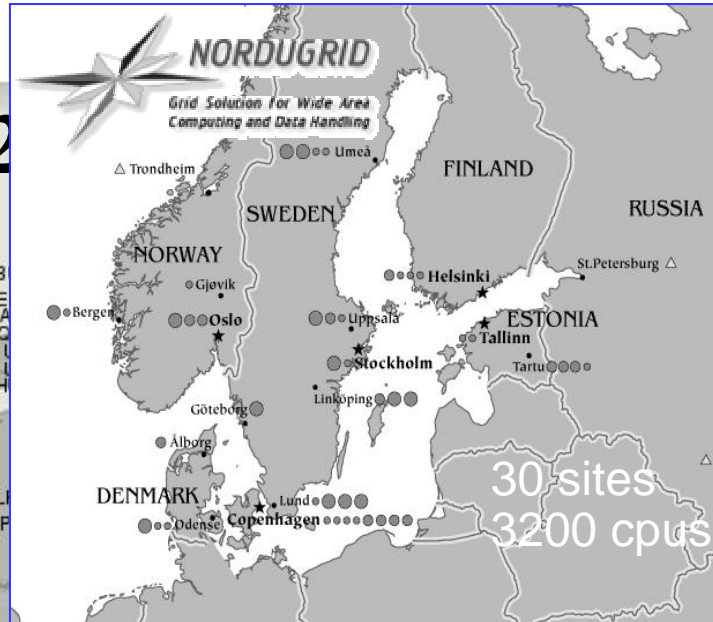


Credits



- Thanks to P. Jenni, L. Robertson for some pretty slide...

LCG-2



- GLASGOW
- LANCS
- LMHEP-LCG2
- MANHEP
- BHAM
- RALPP
- RAL
- OX-PHYSICS
- IC
- RH
- NGS-RAL
- NGS-OXFORD
- NGS-MAN
- NGS-LEEDS
- IN2P3-LI
- IN2P3
- USC
- IFCA
- LIP
- INTA-CAB
- UAM
- CIEMAT
- CNB

Total Sites	82
Total CPUs	7269
Total Storage	6558 (TB)
Wed September 22 2004	

