LHC Software: Crunch Time!

Introduction to the Workshop

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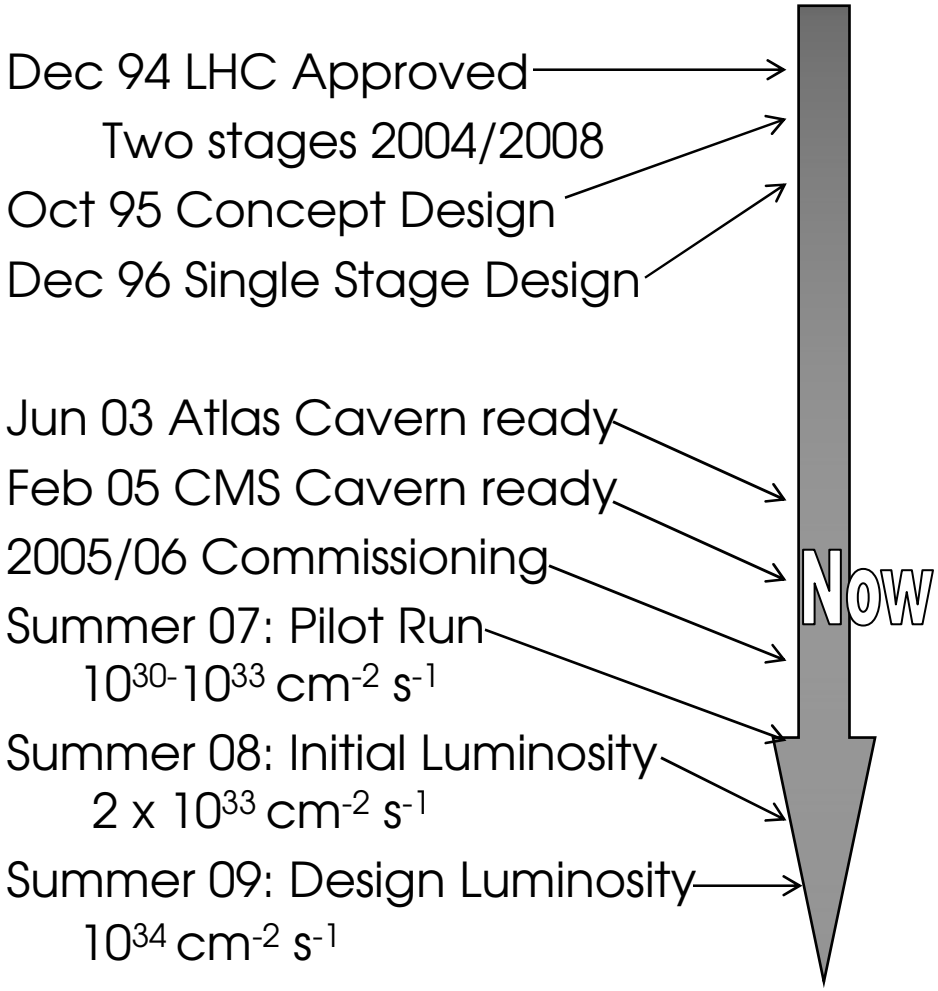
Introduction to the Workshop

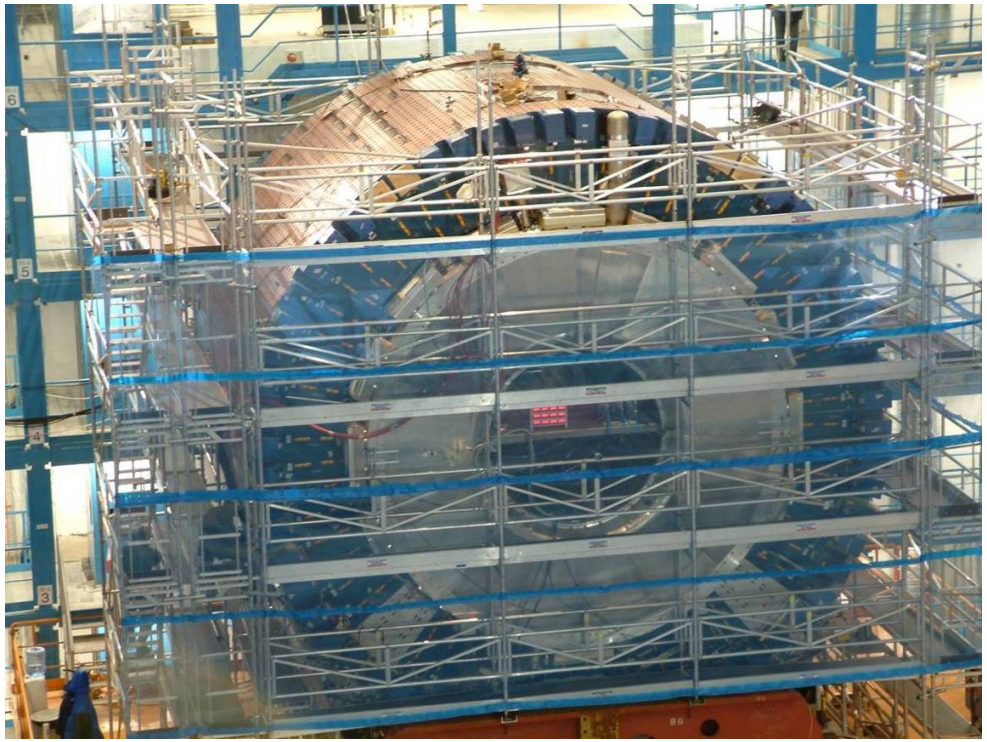
- LHC experimental goals and timeline
- LHC software requirements
- Commonalities in software and computing systems
  - —ROOT, Gaudi and the LGC project
- Questions to the panel and the audience

LHC Goals and Timeline

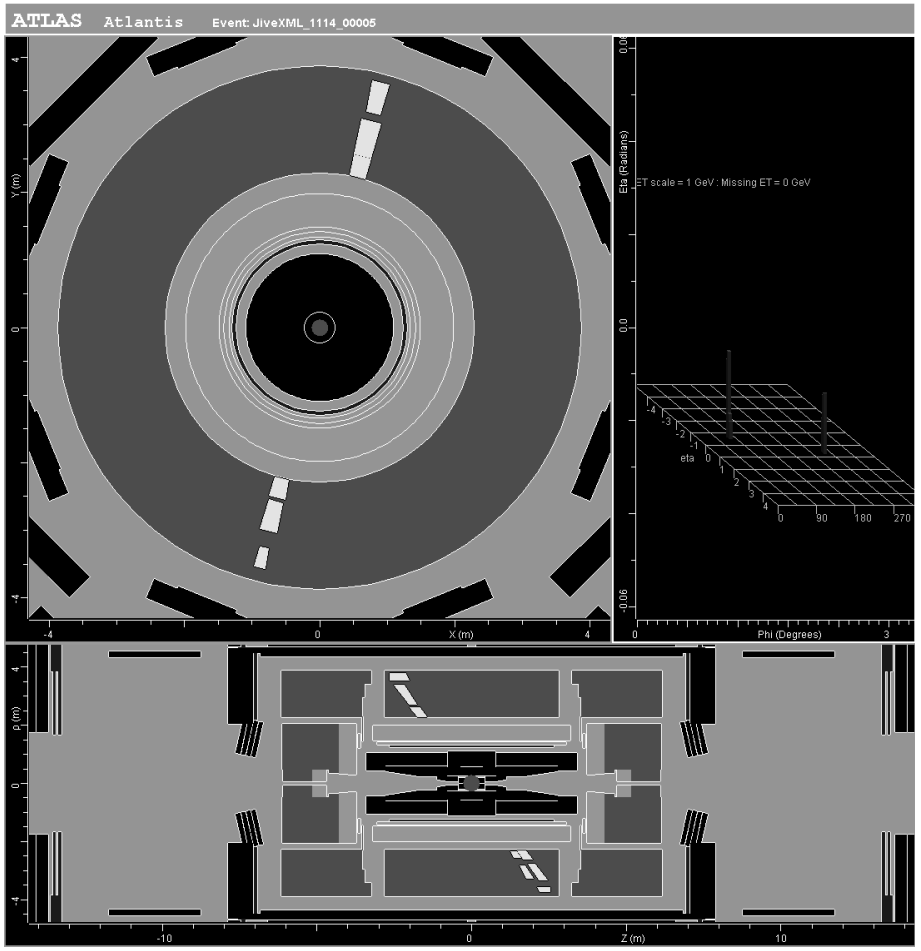
- pp collider:
  7+7 TeV beams@ 10^{34} cm^{-2} s^{-1}
  - EW Simmetry Breaking (Higgs)
  - Physics beyond SM (SUSY)
  - Precision SM physics (CKM, Origin of CP Violation, new physics)
- Pb-Pb collider:
  2.8 TeV/nucleon@10^{27} cm^{-2} s^{-1}
  1.15 PeV CM
  - Quark-gluon plasma



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 cosmics 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 ~10^4 tracks/evt (40% occupancy)
  - Detector complexity (~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

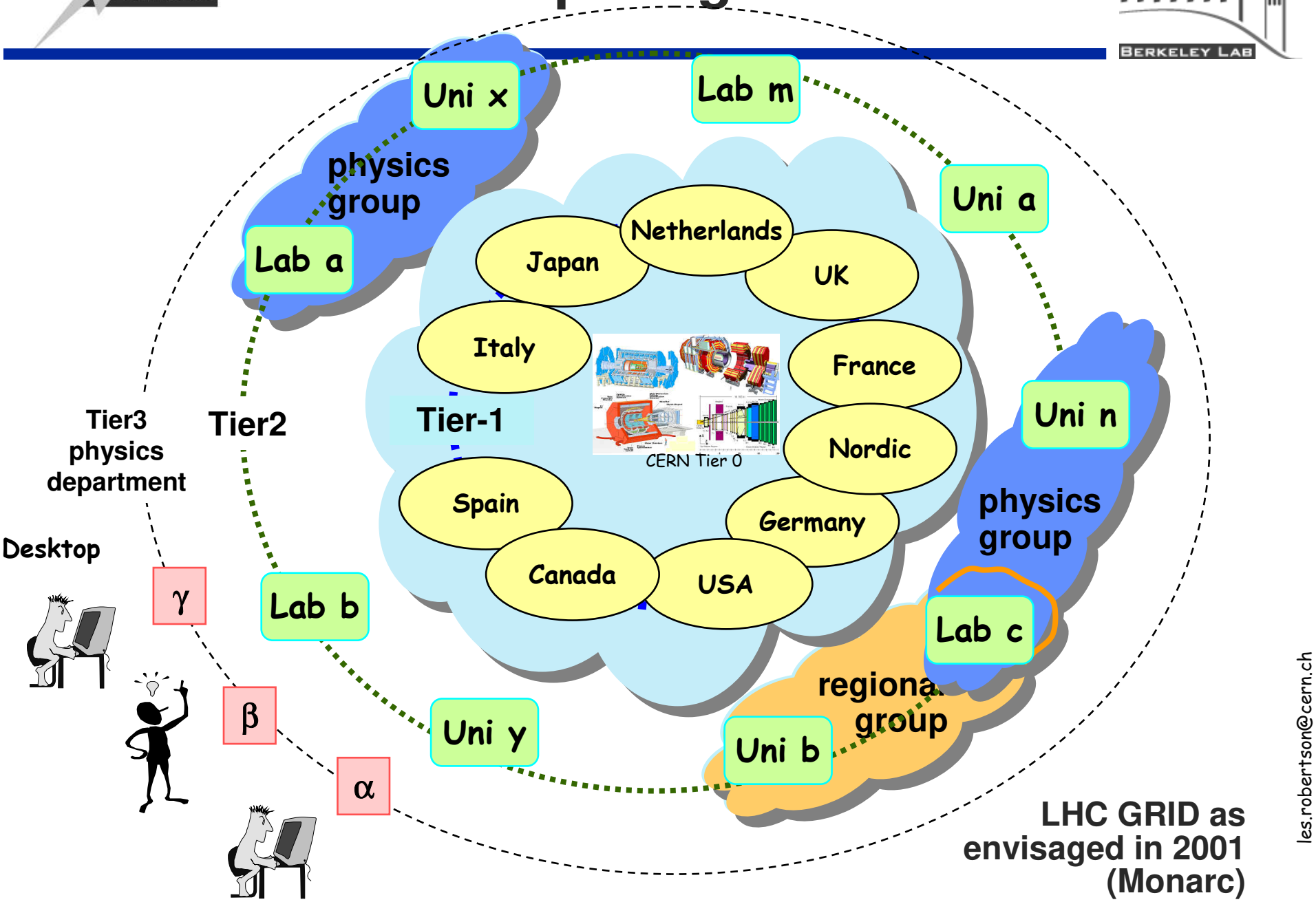
LHC Software Environment

- 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

LHC Computing Environment



LHC GRID as envisaged in 2001 (Monarc)

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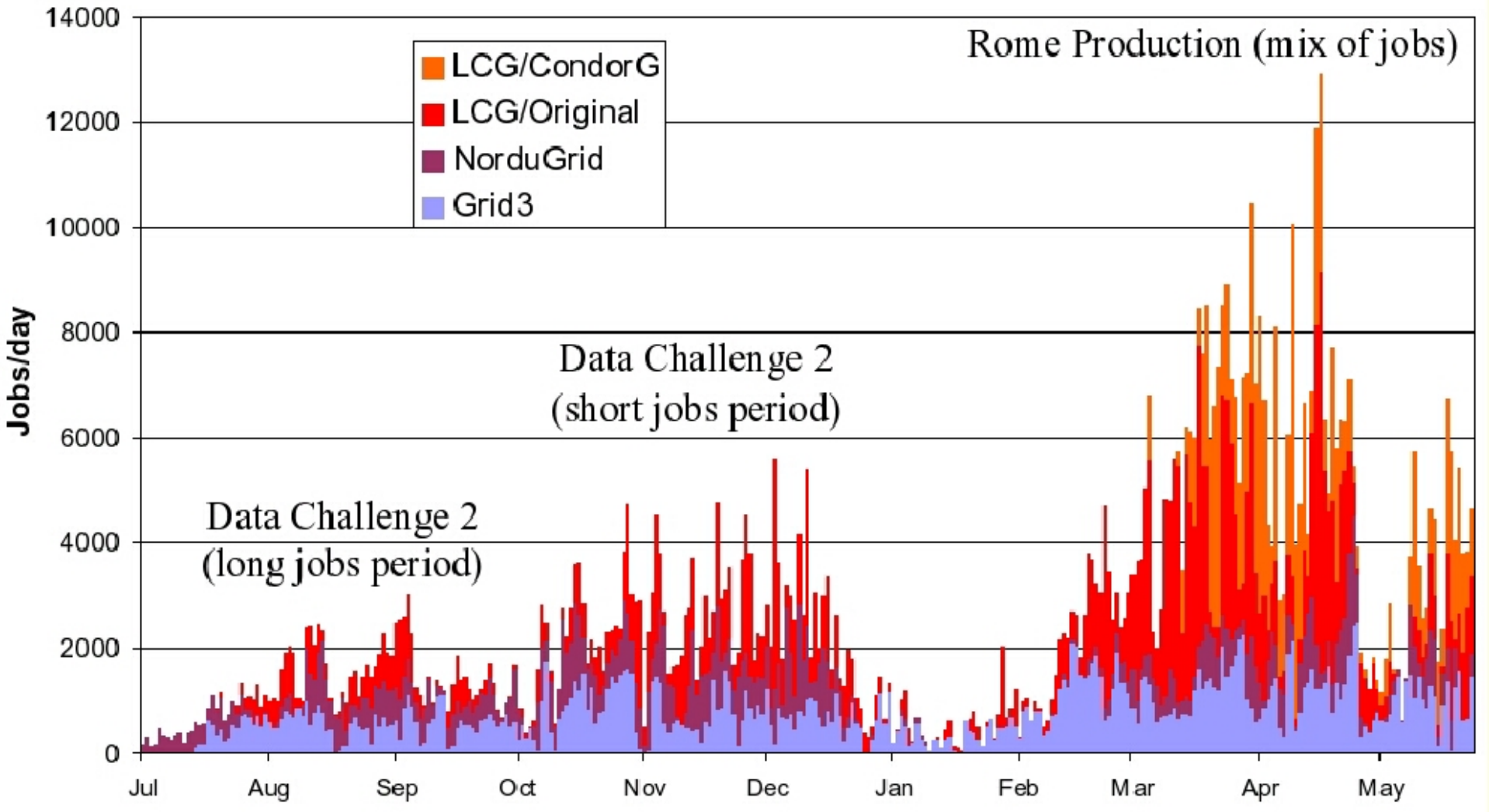
First successful use of the GRID by a large user community in ATLAS



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?

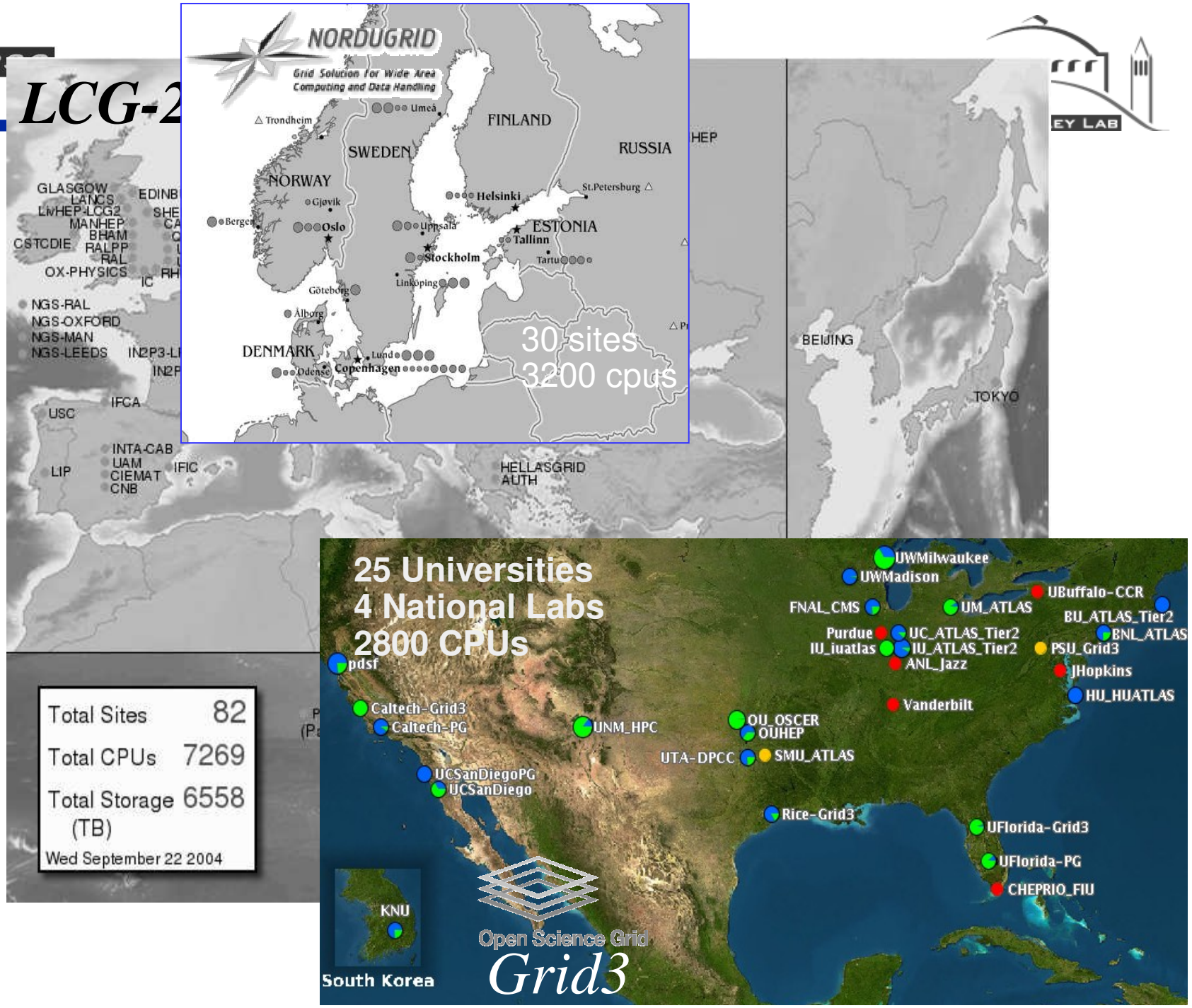
- How are the assumptions in the experiments computing models being tested?
- Are there contingency plans if they turn out to be too optimistic?

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
NORDUGRID
Grid Solution for Wide Area Computing and Data Handling
30 sites
3200 cpus
25 Universities
4 National Labs
2800 CPUs
Total Sites 82
Total CPUs 7269
Total Storage (TB) 6558
Wed September 22 2004
Open Science Grid
Grid3
South Korea