



Status of LHC@home



CERN was founded 1954: 12 European States

“Science for Peace”

Today: 22 Member States

~ 2300 staff
~ 1000 other paid personnel
> 11000 users
Budget (2015) ~1000 MCHF

Member States: Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Israel, Italy, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Spain, Sweden, Switzerland and the United Kingdom

Associate Member in Pre-Stage to Membership: Serbia, Cyprus

Associate Members: India, Pakistan, Turkey, Ukraine

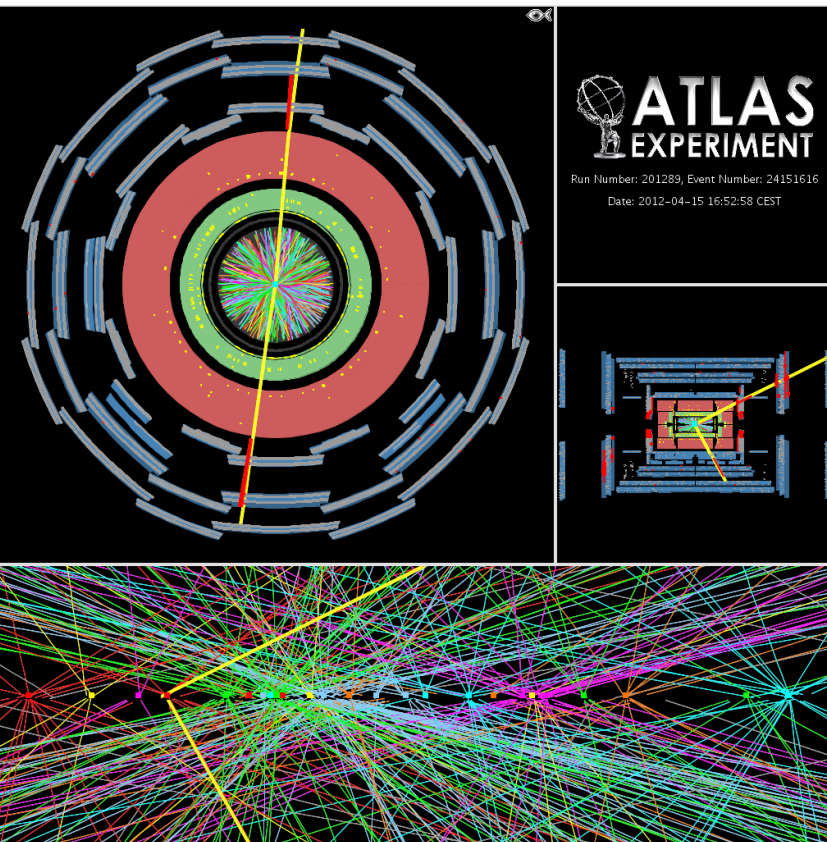
Applicant States for Membership or Associate Membership:
Brazil, Russia, Slovenia

Observers to Council: India, Japan, Russia, Turkey, United States of America; European Commission and UNESCO

LHC accelerator and detectors



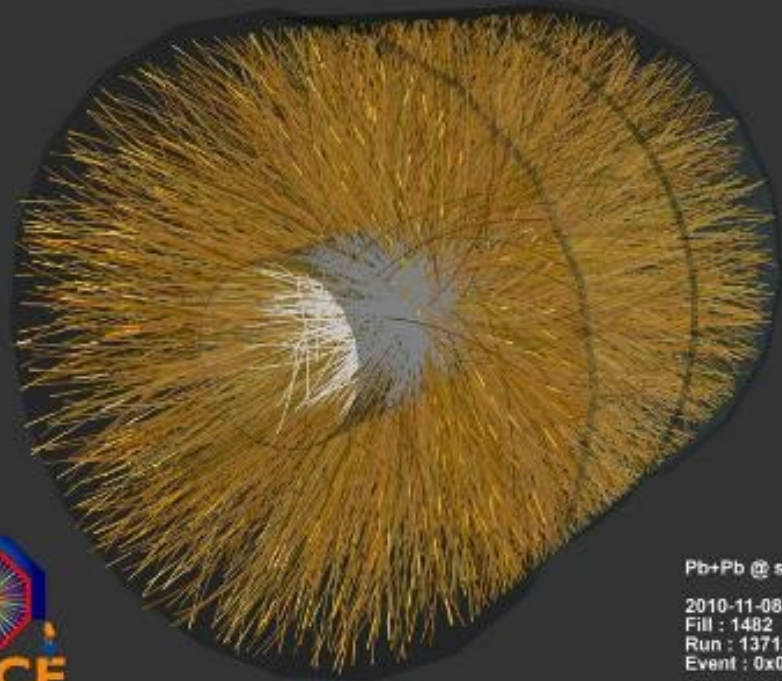
Collisions Produce 1PB/s



- Event filtering – down to 6Gb/s today
- Data reconstruction
- Data analysis
- Find the interesting events

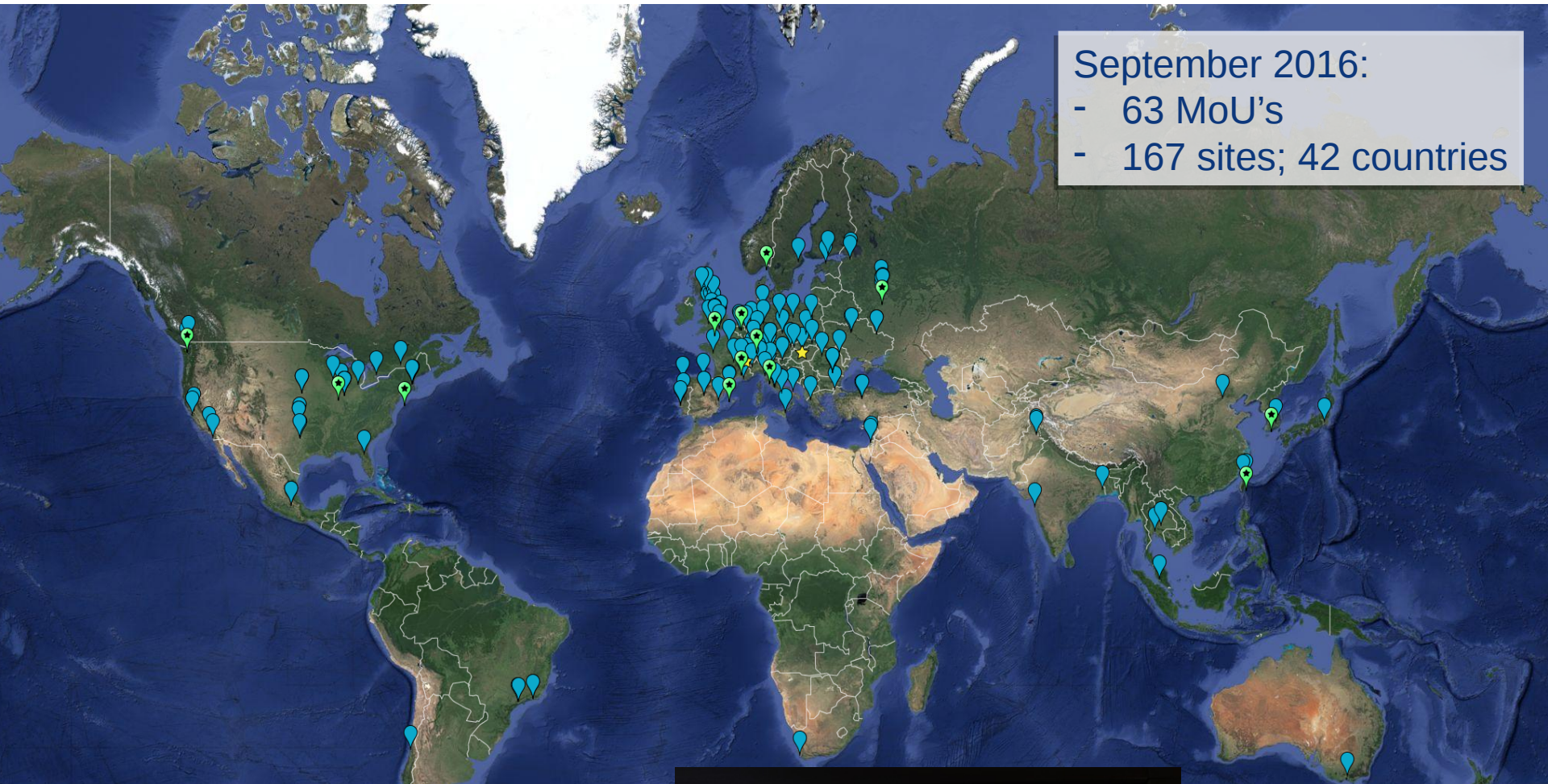
Simulations

- Particle beam trajectories
- Theory behind events
- Events and detectors...



Pb+Pb @ $\sqrt{s} = 2.76$ ATeV
2010-11-08 11:30:46
Fill : 1482
Run : 137124
Event : 0x00000000D3BBE693

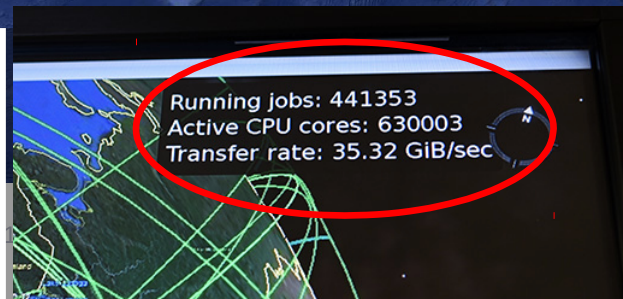
WLCG Collaboration



September 2016:

- 63 MoU's
- 167 sites; 42 countries

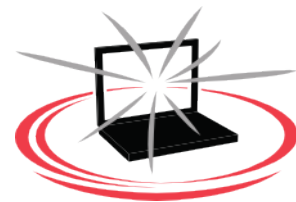
- CPU: 3.8 M HepSpec06
 - If today's fastest cores: ~ 350,000 cores
 - Actually many more (up to 5 yr old cores)
- Disk 310 PB
- Tape 390 PB



Why volunteer computing?



- The **WLCG** has limited resources
 - Fully committed to LHC data reconstruction and analysis
 - Still need a lot more computing for simulations on smaller data sets
- Use additional free* resources
 - 100K hosts achievable for large projects
 - Support for virtualisation - CernVM
- Community engagement
 - Outreach channel
 - Community participation and support



* Attracting and interacting with volunteers has a cost

- Started with in 2004 for the 50th anniversary of CERN. Running the **Sixtrack** application for beam simulations of the stability of proton orbits in the LHC accelerator
- Supplied by Test4Theory as a new BOINC project in 2011, that pioneered the use of virtualization to run physics simulations on a virtual machine (CernVM) on volunteer desktops
- Joined by ATLAS and other LHC experiments from 2014, also using CernVM and CernVfFS, a distributed http file system
- Effort to streamline and consolidate individual initiatives on separate BOINC projects to a common project and to integrate with regular simulation workflows as well as batch computing infrastructure



- **LHC@home consolidated**
 - A single BOINC project with multiple applications
 - Accelerator physics simulations (Sixtrack) as native BOINC app
 - Simulations from ATLAS, CMS, LHCb and Theory running under CernVM and VirtualBox
 - Job management backend integrated with HTCondor – potentially wide range of (low-IO/high CPU) applications

LHC@home consolidation

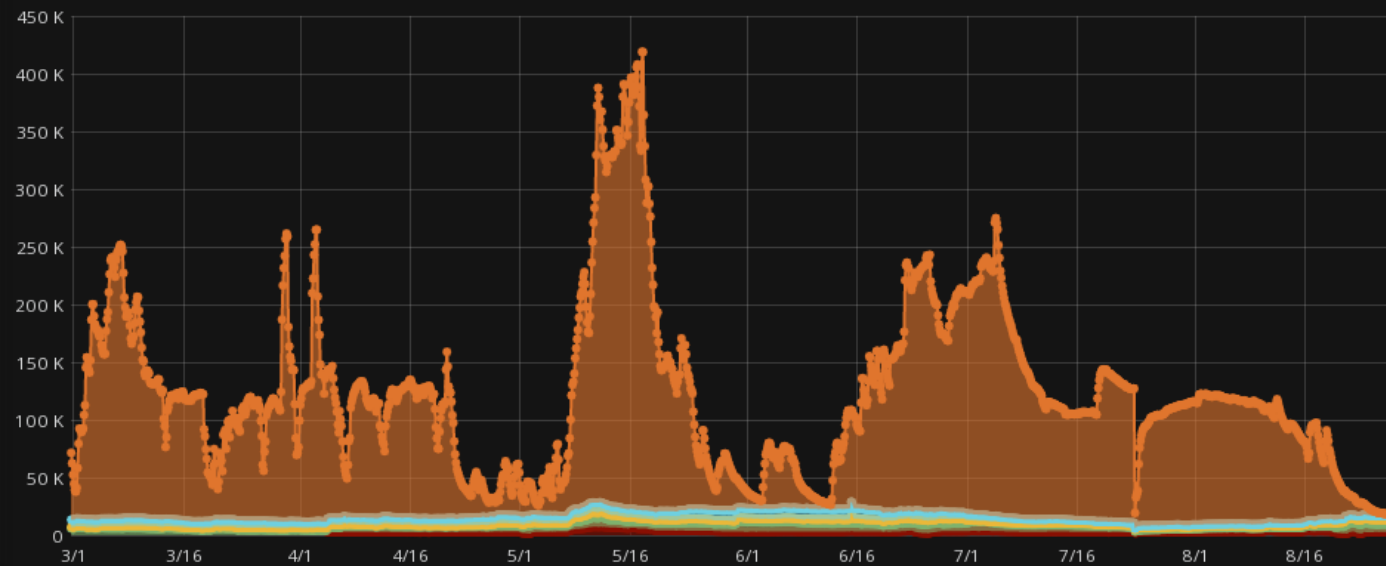
- Production BOINC project: <https://lhcathome.cern.ch/>
 - Consolidated project based on Sixtrack, the original LHC@home
 - For regular volunteers among the general public and desktop grids
 - Credit by application
- Migrated the applications, volunteers and workloads
 - LHCb
 - CMS
 - Theory
 - ATLAS
- Migrated the credit from the old servers to the new server
 - vLHCathome in January this year, ATLAS in April (use email address as key)
- Dev project: <https://lhcatomdev.cern.ch/lhcathome-dev>
 - For motivated volunteers willing to help, on invitation only

LHC@home server setup

- Server setup now scalable
 - Load-balanced web front end
 - Dedicated file upload/download servers
 - Legacy assimilation and validator server for Sixtrack
 - Also serving old http-only BOINC clients for Sixtrack
- Remote submission from HTCondor
 - Implemented for Sixtrack using Boinc-Condor GAHP
 - Run Condor directly in VM for other applications
 - *More details in Laurence's talk tomorrow!*

LHC@home Service Statistics

Running Tasks



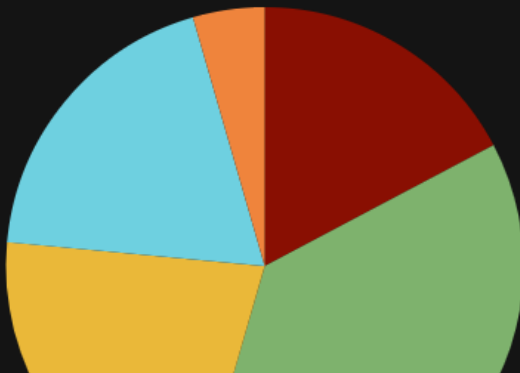
	min	max	avg	current
— sixtrack	810.0	397.4 K	106.0 K	810.0
— ATLAS	1.3 K	7.4 K	3.3 K	3.0 K
— Theory	1.2 K	9.4 K	5.6 K	3.3 K
— LHCb	531.0	9.0 K	2.3 K	3.8 K
— CMS	1.2 K	8.9 K	5.6 K	6.5 K

Running Tasks

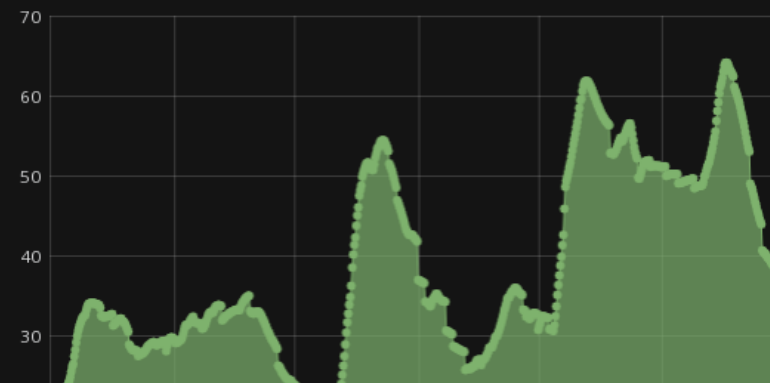
⊙ Last 20 minutes

values percentage

— LHCathome ATLAS	3021	17.26%
— LHCathome CMS	6513	37.22%
— LHCathome LHCb	3847	21.99%
— LHCathome Theory	3334	19.05%
— LHCathome sixtrack	783	4.47%



FLOPS



LHC@home - challenges

- Scheduling of tasks
 - Sixtrack (classic BOINC app) has occasional bursts of 100k + short simulation jobs
 - VM apps provide a steady flow of tasks
- How to ensure optimal scheduling?
 - Increased scheduler shared memory buffer and weight of Sixtrack to carry out faster dispatching
 - Feeder query is slow with many tasks in the queue
 - More hints on scheduler tuning welcome!

BOINC server code and upgrades

- BOINC software upgrades on LHC@home have been done on an occasional basis, e.g. to test new features in our dev project or after security announcements on the boinc_projects list
- Typically just a git fetch from Github, build and then upgrade
- Post-upgrade fixes often necessary
 - Until recently, project specific web customisation in html/project was respected
- Wishlist:
 - Stable server releases
 - Separation of server components (scheduler, daemons) and web components (php pages)
 - Extend authn/authz to allow external identity providers

LHC@home - next steps

- Attract more volunteers, also institute/CERN desktops
 - Review and improve web presence
 - *Outreach actions*
- Scale up and evolve infrastructure according to need
 - Enable HTCondor gateway for all applications
- Work with the VC community to evolve BOINC software

References

- <http://cern.ch/lhcathome>
- <http://boinc.berkeley.edu>

Questions?



www.cern.ch