

# Grid Computing – a new tool for science



**CERN, the European Organization for Nuclear Research**

**Dr. Wolfgang von Räden**

# CERN stands for over 50 years of

- fundamental research and discoveries
- technological innovation
- training and education
- bringing the world together



**1954 Rebuilding Europe**  
First meeting of the  
CERN Council



**1980 East meets West**  
Visit of a delegation from Beijing



**2004 Global Collaboration**  
The Large Hadron Collider  
involves over 80 countries

# CERN's mission in Science

- Understand the fundamental laws of nature
  - We accelerate elementary particles and make them collide.
  - We observe the results and compare them with the theory.
- Provide a world-class laboratory to researchers in Europe and beyond
- A few numbers ...
  - 2500 employees: physicists, engineers, technicians, craftsmen, administrators, secretaries, ...
  - 6500 visiting scientists (half of the world's particle physicists), representing 500 universities and over 80 nationalities
  - Budget: ~1 Billion Swiss Francs per year
  - Additional contributions by participating institutes

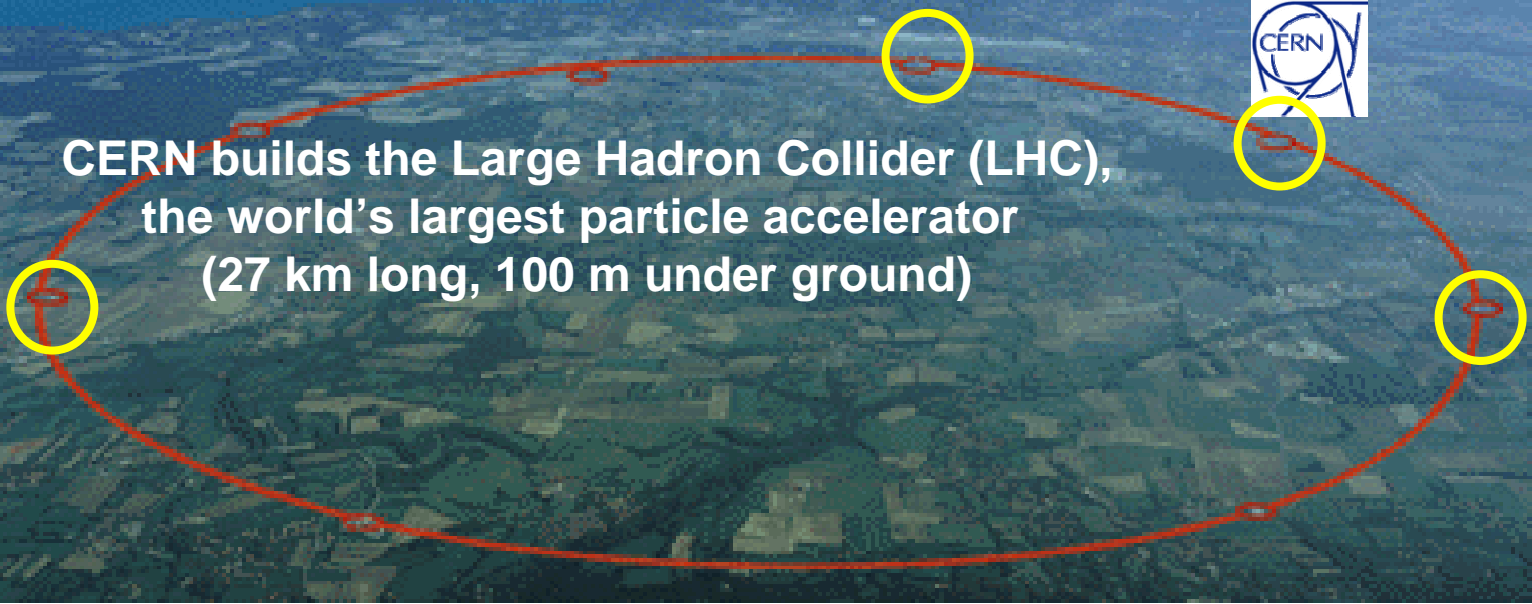
# The CERN site near Geneva

Collaborators from around the world build four huge experiments to observe the collisions

Geneva



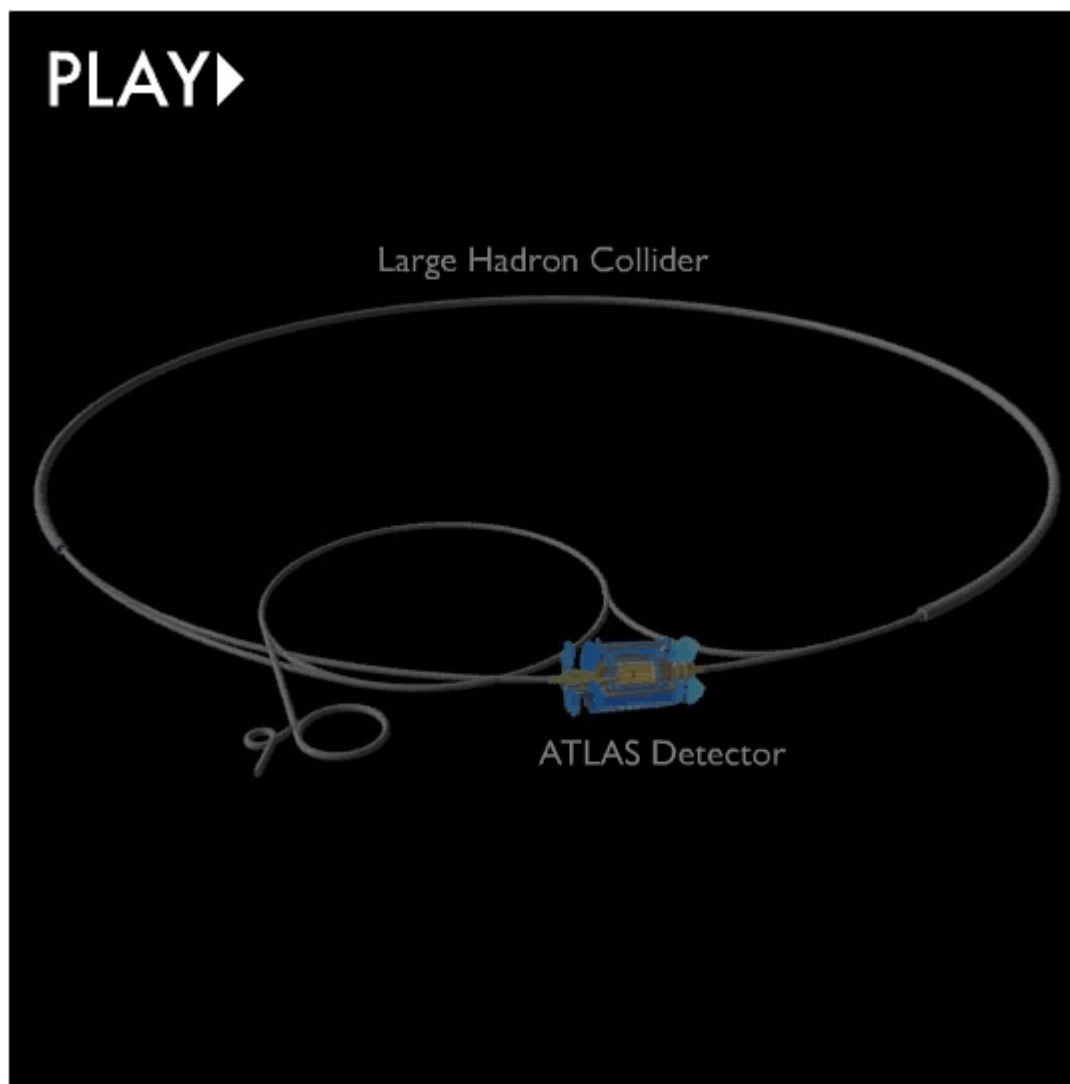
CERN builds the Large Hadron Collider (LHC),  
the world's largest particle accelerator  
(27 km long, 100 m under ground)



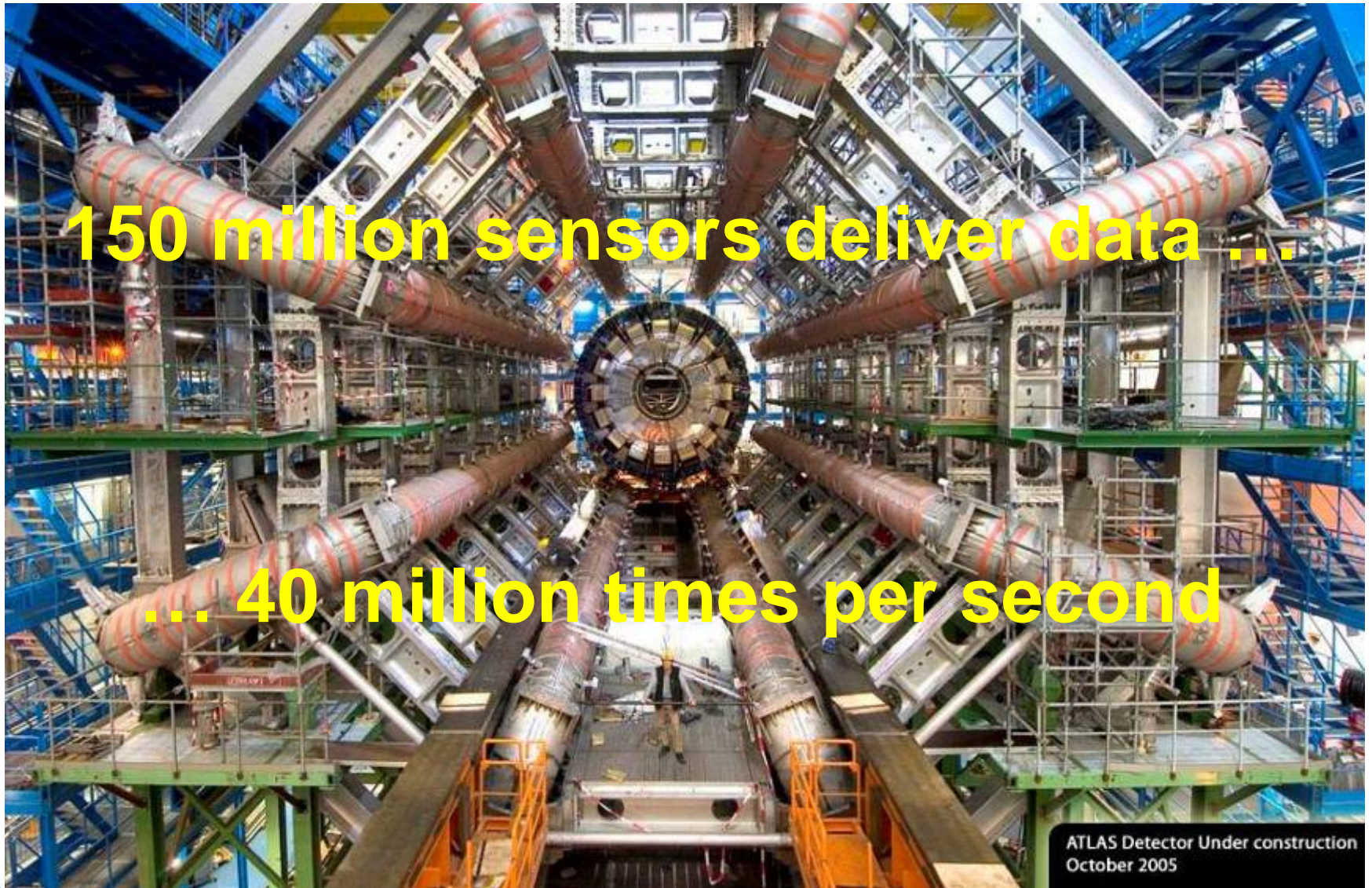


**View of the LHC tunnel**

# Accelerating and colliding particles

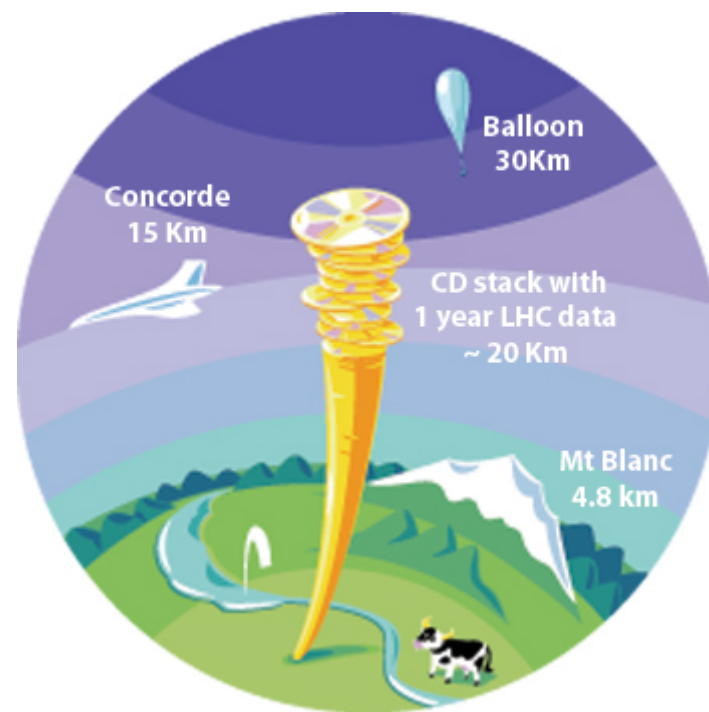


# View of the ATLAS detector (under construction)



# The Data Challenge

- The accelerator will be completed in 2007 and run for 10-15 years.
- Experiments will produce about **15 Million Gigabytes** of data each year (about 20 million CDs!) .
- LHC data analysis requires a computing power equivalent to **~100,000 of today's fastest PC processors.**
- Requires many cooperating computer centres, as CERN can only provide ~20% of the capacity.



**Therefore, we build a Computing Grid**



# The Grid connects Instruments, Computer Centres and Scientists

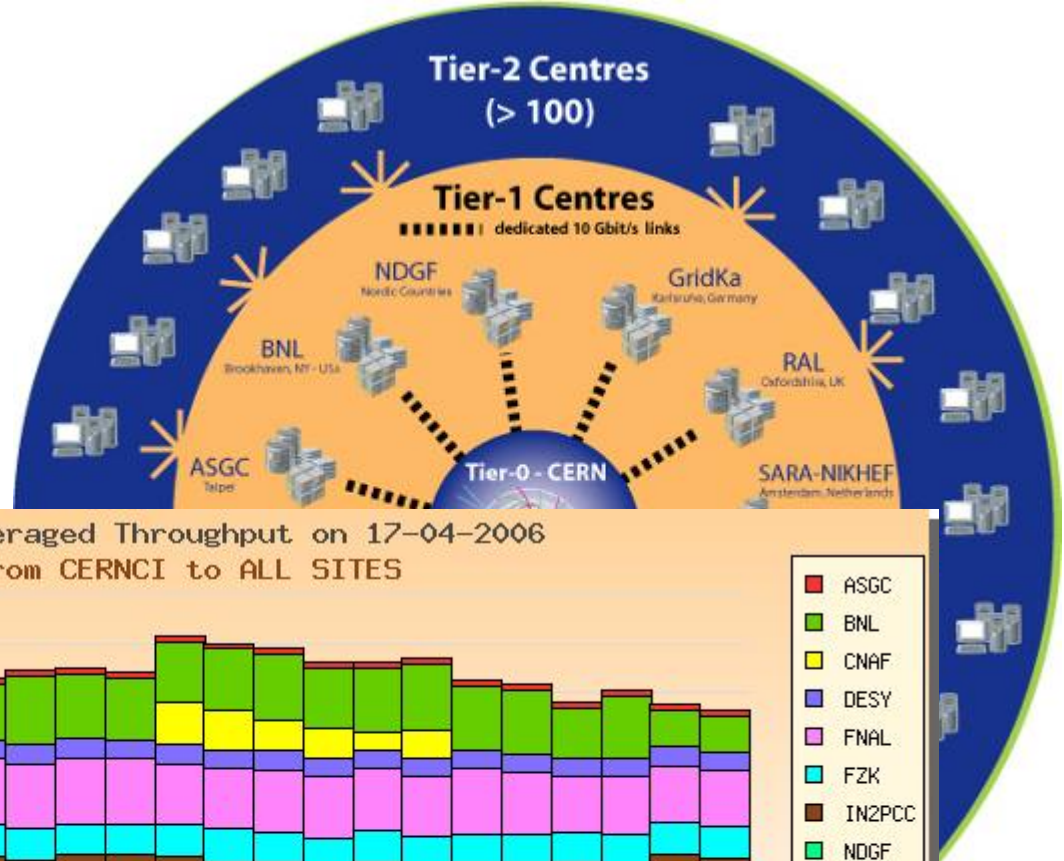


The Web, invented at CERN, shares information  
The Grid shares computing power and storage

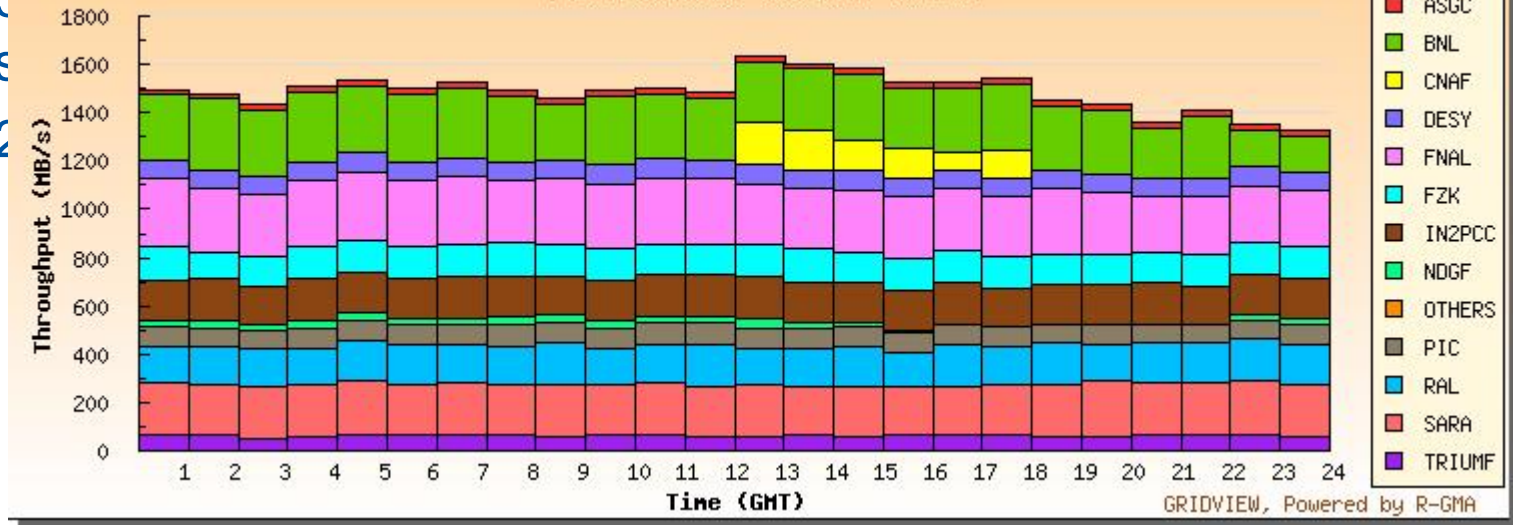


# LHC Computing Grid project (LCG)

- More than 100 computing centres
- 12 large centres for primary data management: CERN (Tier-0) and eleven Tier-1s

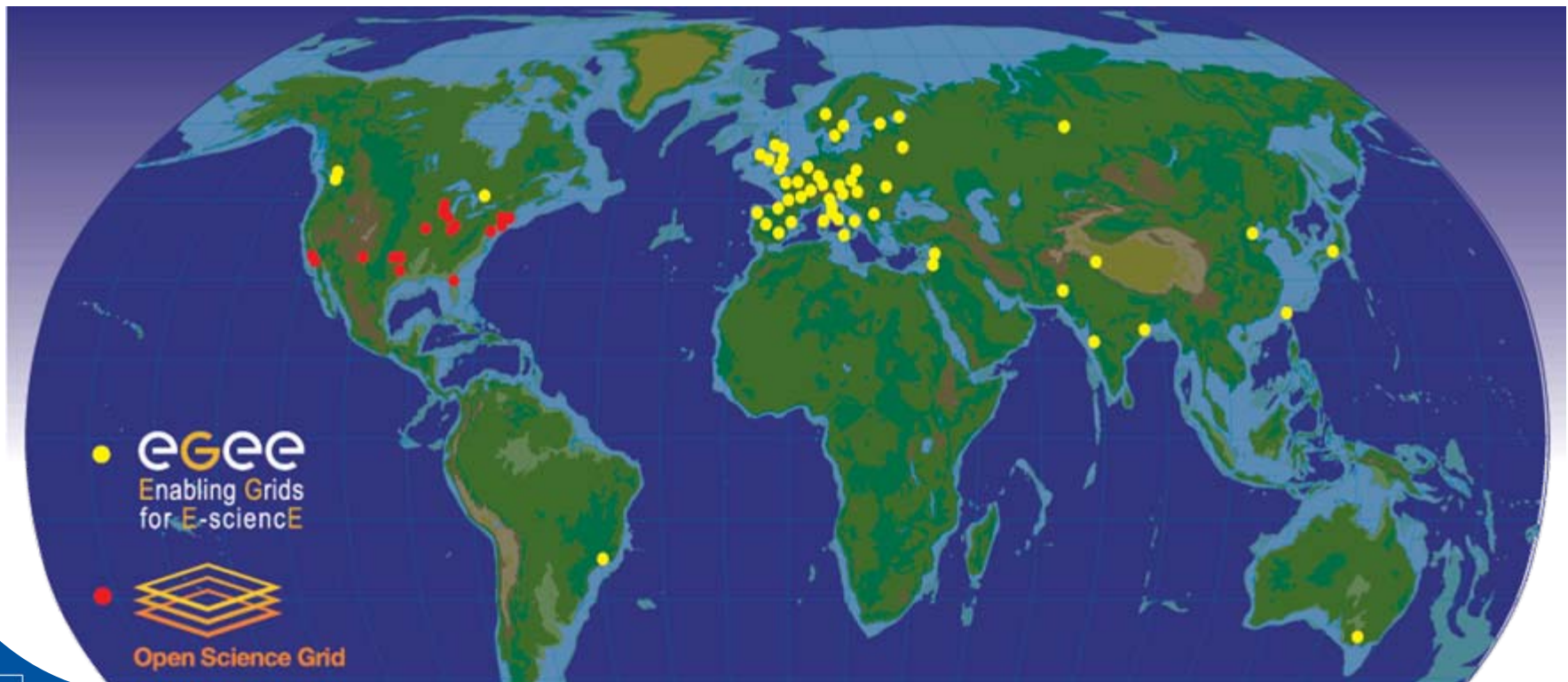


Hourly Averaged Throughput on 17-04-2006  
From CERNCI to ALL SITES



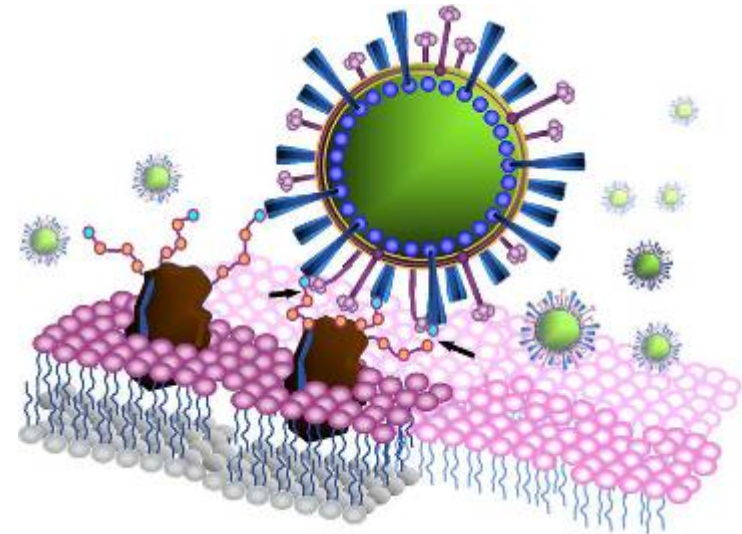
# The Grid used by CERN and its partners

- Today: >200 sites in 30 countries with >22,000 PCs
- The **EGEE** and **OSG** projects are the basis
- Over 25 applications in nine scientific domains



# Recent example: EGEE Attacks Avian Flu

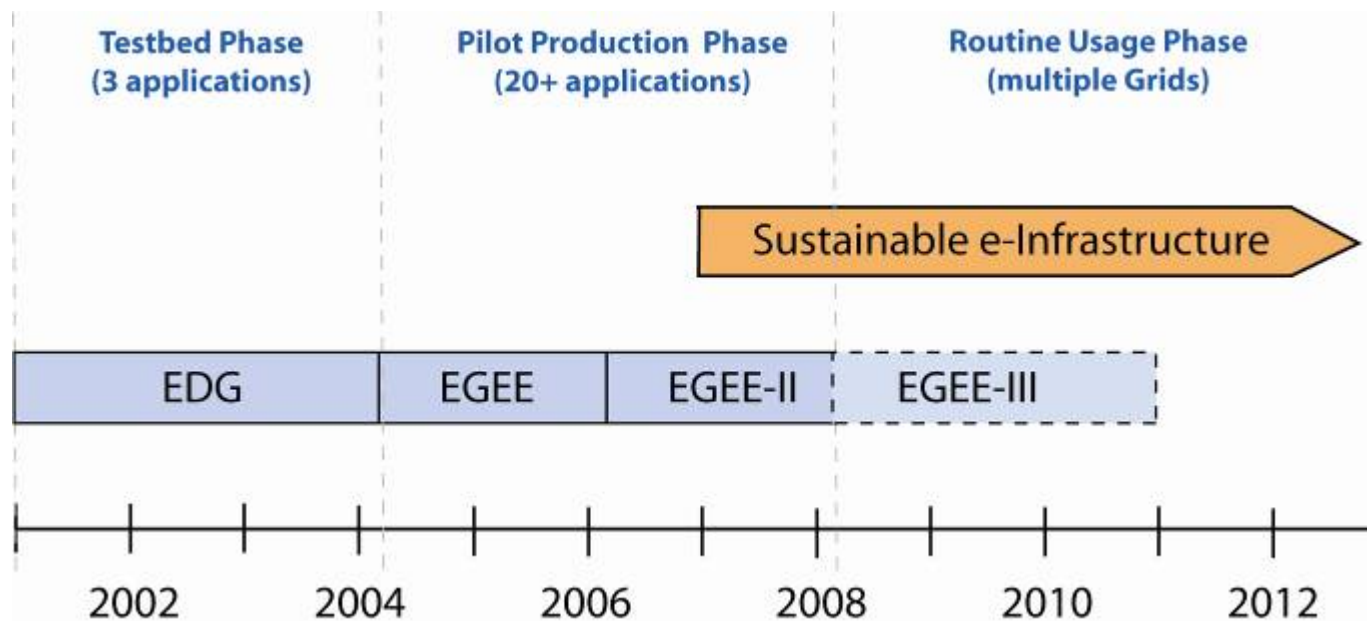
- EGEE used to analyse 300,000 possible potential drug compounds against bird flu virus, H5N1.
- 2000 computers at 60 computer centres in Europe, Russia, Asia and Middle East ran during four weeks in April - the equivalent of 100 years on a single computer.
- Potential drug compounds now being identified and ranked.



*Neuraminidase, one of the two major surface proteins of influenza viruses, facilitating the release of virions from infected cells. Image Courtesy Ying-Ta Wu, AcademiaSinica.*

# Towards a European Grid Infrastructure

- Europe is in a leading position in scientific Grids thanks to EGEE
- Must ensure transition from projects to a sustainable e-infrastructure
- Requires creation of National Grid Infrastructures
- Requires coordination by a new European Organization (FP7)
- Requires the support of European Governments



# CERN openlab phase 1 (2003-05)

- Industry partners provide state of the art technology, manpower
- CERN does test and validation in demanding Grid environment



# CERN openlab phase 2 (2006-08)

- Platform competence centre
- Grid interoperability centre
- Security activities
- Joint events



## PARTNERS



## CONTRIBUTORS



# In Summary

- Grid Computing is a new technology providing unprecedented capabilities for science and industry.
- CERN and its partners are the major drivers due to the computing needs created by the LHC project.
- A global and sustainable Grid infrastructure is required.
- In Europe, we propose to establish National Grid Infrastructures, coordinated by a European Organization.
- We work towards interoperation with similar projects around the world.
  
- Link for live monitor:  
<http://goc.grid-support.ac.uk/gridsite/monitoring>