Grid Computing Development in Institute of High Energy Physics

Inauguration Ceremony of HKU Grid Point
August 27, 2010

Gang Chen
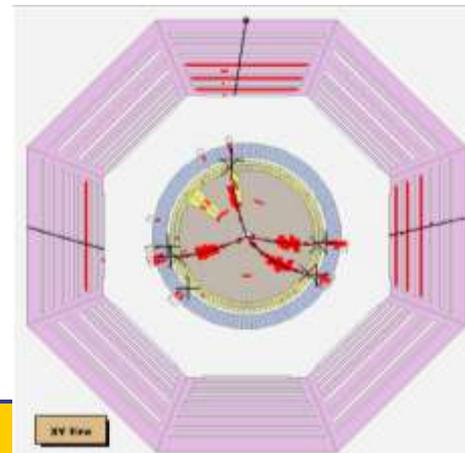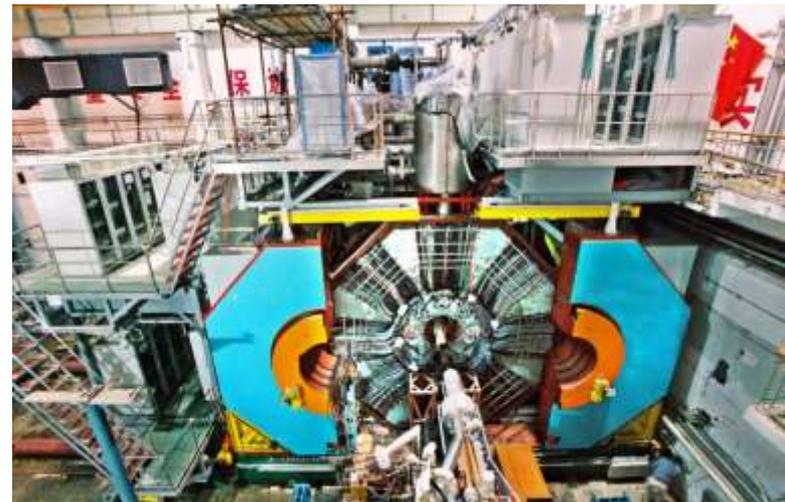### IHEP, CAS

IHEP at a Glance

- **1000+ staffs, 2/3 scientists and engineers**

- **The largest fundamental research center in China with research fields:**

  - **Experimental Particle Physics**

  - **Theoretical Particle Physics**

  - **Astrophysics and cosmic-rays**

  - **Accelerator Technology and applications**

  - **Synchrotron radiation and applications**

  - **Nuclear analysis technique**

  - **Computing and Network application**

  - **…**

BEPCII/BESIII

BEPC: Beijing Electron-Positron Collider

- upgrade: BEPCII/BESIII, operational in 2008
  - 2.0 ~ 4.6 GeV/C
  - $(3\sim10)\times10^{32}$ cm^{-2}s^{-1}
- 36 Institutions from China, US, Germany, Russian, Japan,…
  - HKU as member!
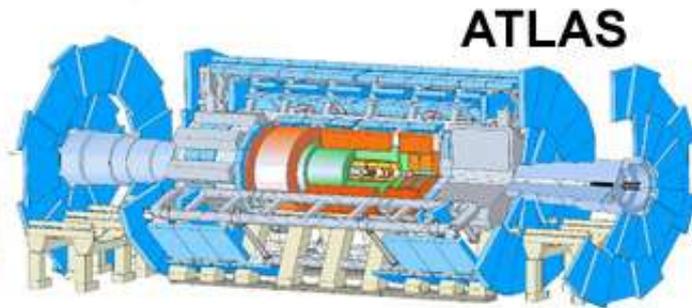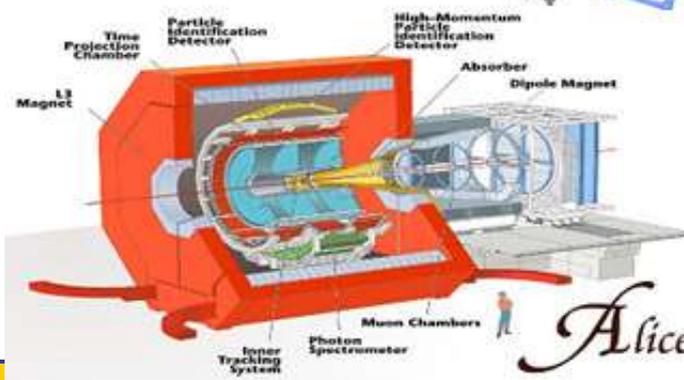- 6000+ KSI2K for data process and physics analysis
- 5+ PB in five years

LHC

- **China is involved in all 4 LHC experiments**
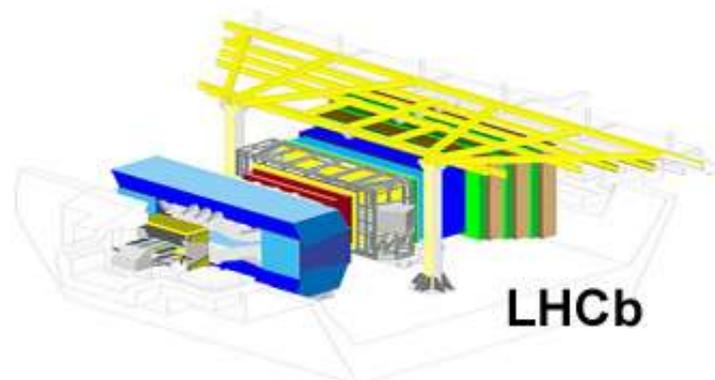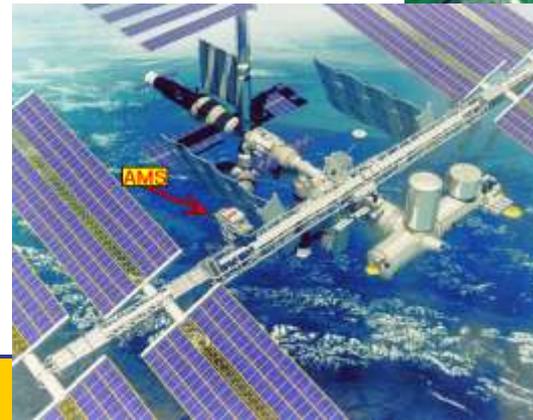 - **SDU, NJU, USTC, PKU, Tsinghua, CCNU,…**
- **IHEP/CAS in ATLAS and CMS.**

More projects

- **Cosmic-ray observatory at Yangbajing in Tibet**
- **Daya-Bay Neutrino Experiment**
- **Alpha Magnetic Spectrometer (AMS)**
- **....**

- **Members of International Collaborations, huge computing demands.**
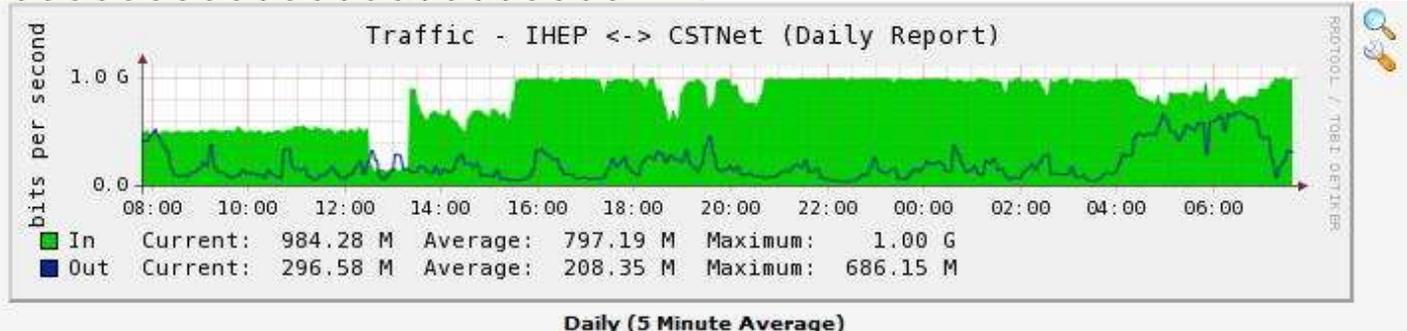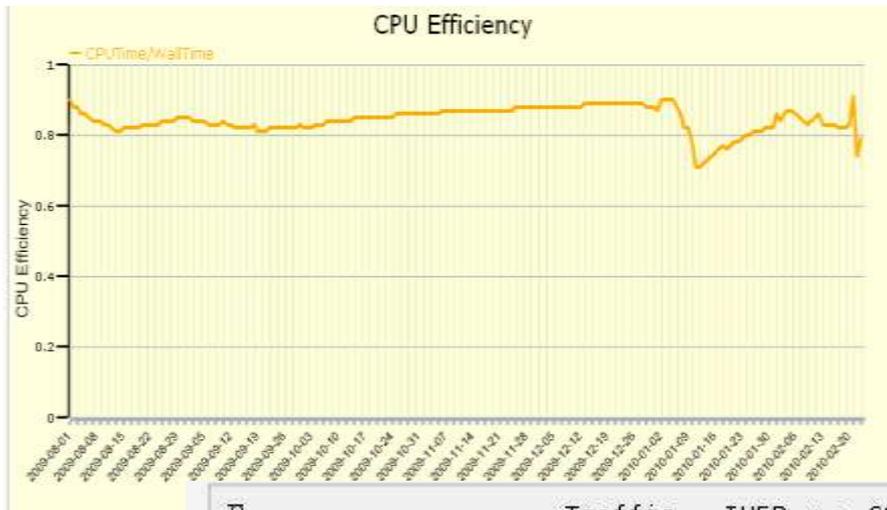
HEP Grid in China

- **HEP related projects needs a solution of computing**
- **China has a fair contribution to the construction of LHC detectors**
- **Access to the LHC data for scientific research: A grid computing system is necessary:**
  - **No Computing, No Physics**
- **A data-intensive grid has been established, supported by Chinese Academy of Sciences (CAS)**

# HEP Grid sites

PKU

IHEP

SDU

USTC

NJU

eGee
Enabling Grids
for E-sciencE

Scheduled = 15971
Running = 27126

Imperial College
London

GridPP

07:36:31 UTC (3 minutes ago)

10-8-27 - 7

Tier-2 site at IHEP

- **Associated with CC-IN2P3 in Lyon**
- **Work nodes with 1100 cores**
- **600 TB disk space**

CPU Efficiency

Traffic - IHEP <-> CSTNet (Daily Report)

	Current:	Average:	Maximum:
In	984.28 M	797.19 M	1.00 G
Out	296.58 M	208.35 M	686.15 M

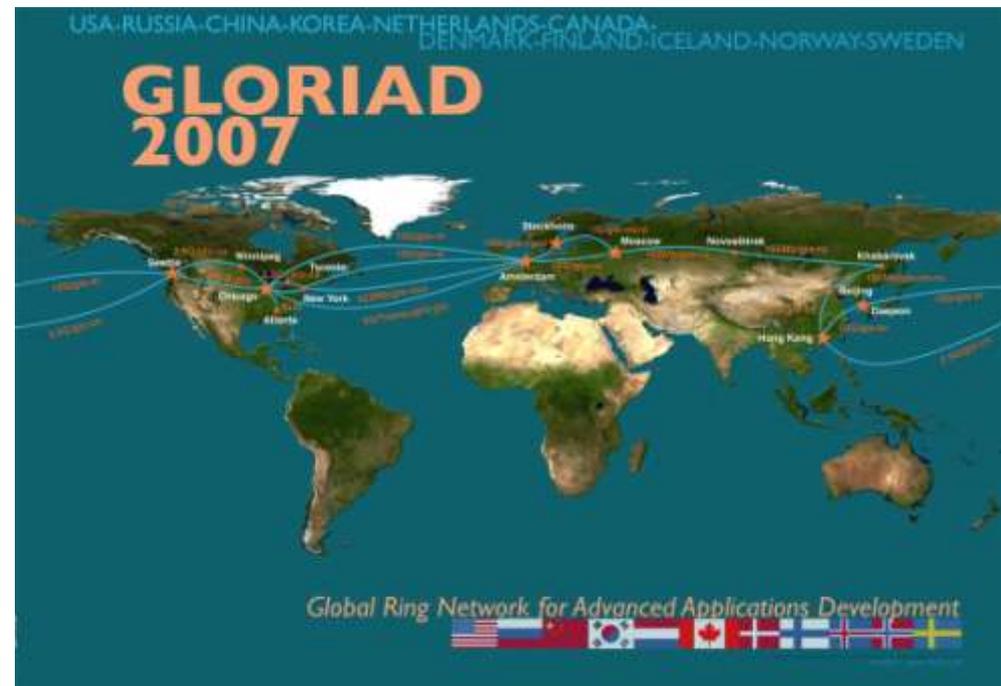Daily (5 Minute Average)
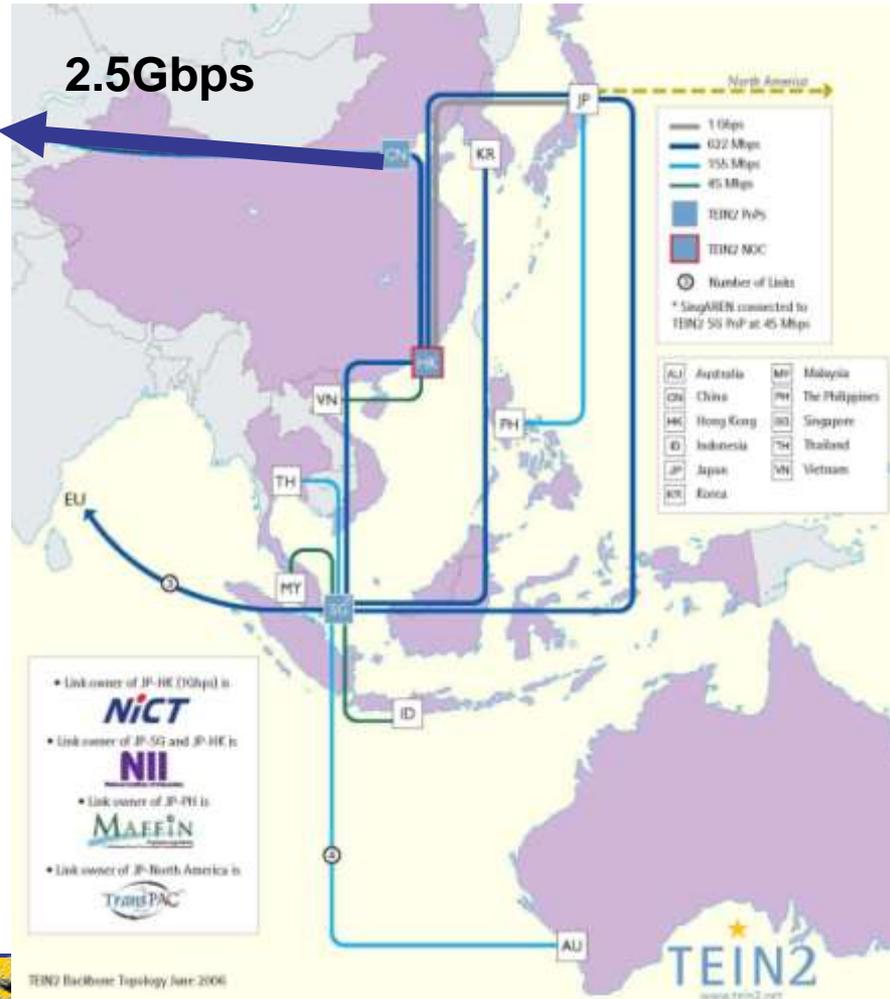
China CA

- **Grid Security Infrastructure**
  - **Accredited by EUGridPMA and APGridMPA**
  - **Based on X.509 PKI**
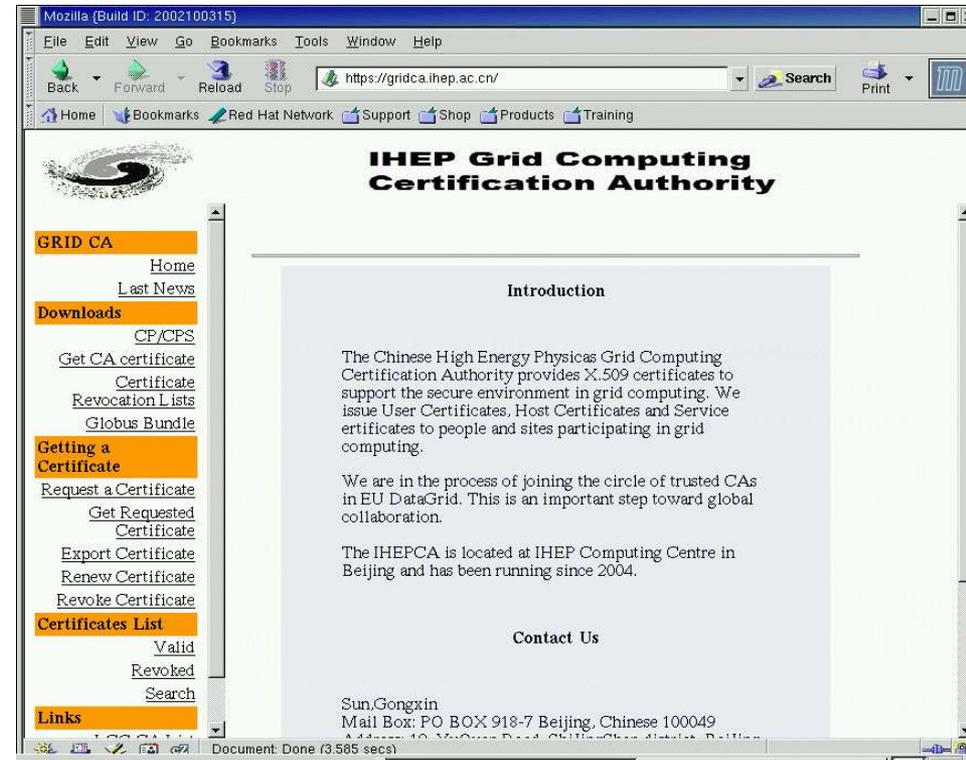
Networking

Via ORIENT/TEIN3 to Europe

Via Gloriad to US

2.5Gbps

CMSROC@Beijing

- ## CMS Remote Operation Center

  - **monitoring detector subsystems and Grid computing system**

  - **Cover the third time zone for CMS remote shift**

  - **Not only sharing computing resources but also manpower**

Applications of HEP Grid

- **Existing:**
  - **LHC: ATLAS and CMS**
  - **ARGO-YBJ**
  - **Bio-Info, Bio-Med: WISDOM, …**
- **Under-planning and testing:**
  - **BESIII**
  - **Daya Bay**
  - **Geodynamics**
  - **….**

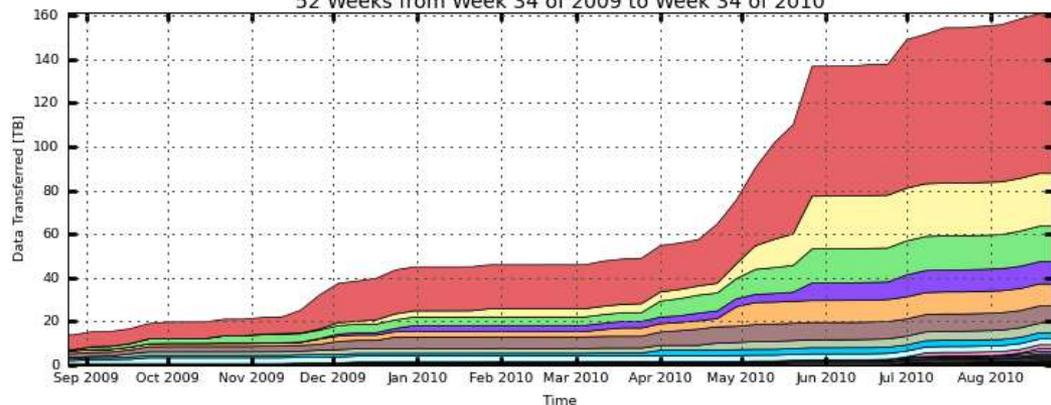# Applications of HEP Grid

- **Services provided in one year:**
  - **7.3 million CPU-hours of computing**
  - **2.1 million jobs**
  - **Hundreds of TB data transferred from/to the grid sites in the world**

BEIJING-LCG2 Total
ALL VOs. Sept

The following table shows the distribution

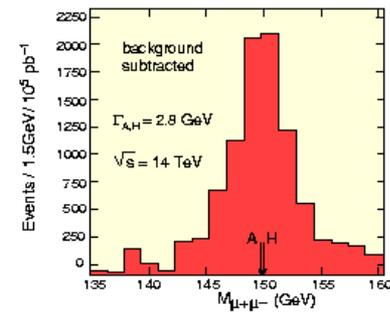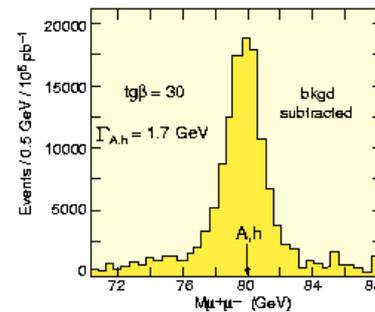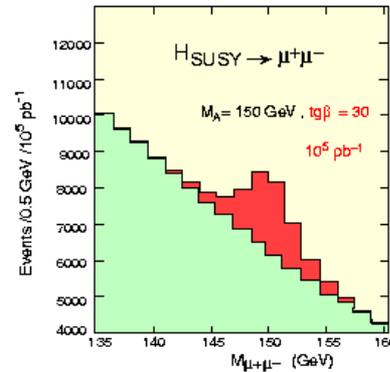| SITE	argo	atlas	bes	bi
BEIJING-LCG2	1,501	1,321,412	356	
Total	1,501	1,321,412	356	
Percentage	0.07%	62.36%	0.02%	

CMS PhEDEx - Cumulative Transfer Volume
52 Weeks from Week 34 of 2009 to Week 34 of 2010

- T1_US_FNAL_Buffer to T2_CN_Beijing
- T2_CH_CSCS to T2_CN_Beijing
- T1_ES_PIC_Buffer to T2_CN_Beijing
- T2_US_Florida to T2_CN_Beijing
- T2_FI_HIP to T2_CN_Beijing
- T2_US_MIT to T2_CN_Beijing
- T2_IT_Legnaro to T2_CN_Beijing
- T3_US_FNALLPC to T2_CN_Beijing
- T3_US_Omaha to T2_CN_Beijing
- T2_UK_London_IC to T2_CN_Beijing
- T1_DE_KIT_Buffer to T2_CN_Beijing
- T1_UK_RAL_Buffer to T2_CN_Beijing
- T1_TW_ASGC_Buffer to T2_CN_Beijing
- T2_US_Wisconsin to T2_CN_Beijing
- T2_DE_DESY to T2_CN_Beijing
- T2_DE_RWTH to T2_CN_Beijing
- T2_ES_IFCA to T2_CN_Beijing
- T2_US_Purdue to T2_CN_Beijing
- T2_US_Nebraska to T2_CN_Beijing
- T2_IT_Bari to T2_CN_Beijing
- T1_IT_CNAF_Buffer to T2_CN_Beijing
- T1_FR_CCIN2P3_Buffer to T2_CN_Beijing
- XT1_DE_FZK_Buffer to T2_CN_Beijing
- T2_IT_Pisa to T2_CN_Beijing
- T1_CH_CERN_Buffer to T2_CN_Beijing
- T2_ES_CIEMAT to T2_CN_Beijing
- T2_RU_JINR to T2_CN_Beijing
- T2_US_UCSD to T2_CN_Beijing
- T2_FR_IPHC to T2_CN_Beijing

Total: 160.83 TB, Average Rate: 0.00 TB/s

Physics Simulation

ATLAS MC Study

ttH-2L selection
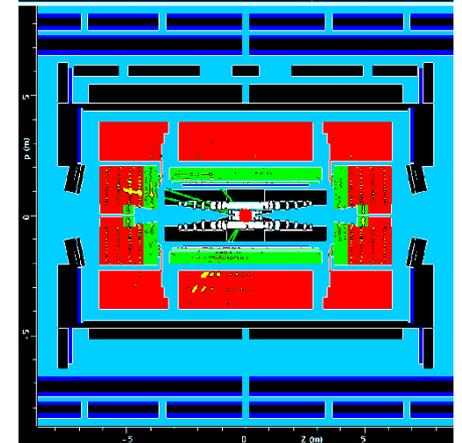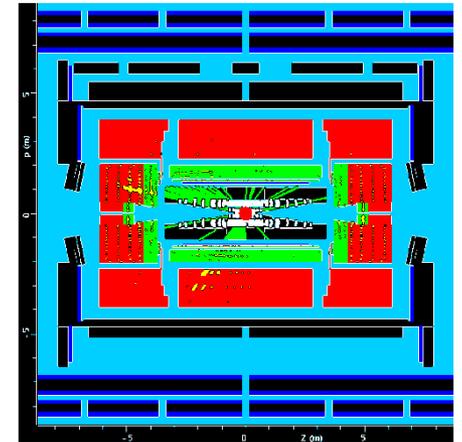

ttbar mimic to ttHWW

ttH(2l2b4j2υ) full simulation event display

LHC First Physics

LHC Page1 | Fill: 1005 | E: 3500 GeV | 30-03-2010 14:37:02

PROTON PHYSICS: STABLE BEAMS

Energy: 3500 GeV | I(B1): 1.54e+10 | I(B2): 1.33e+10
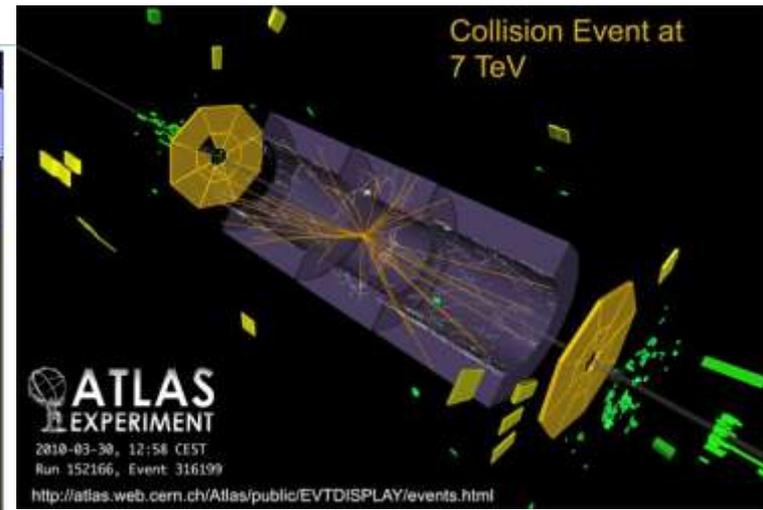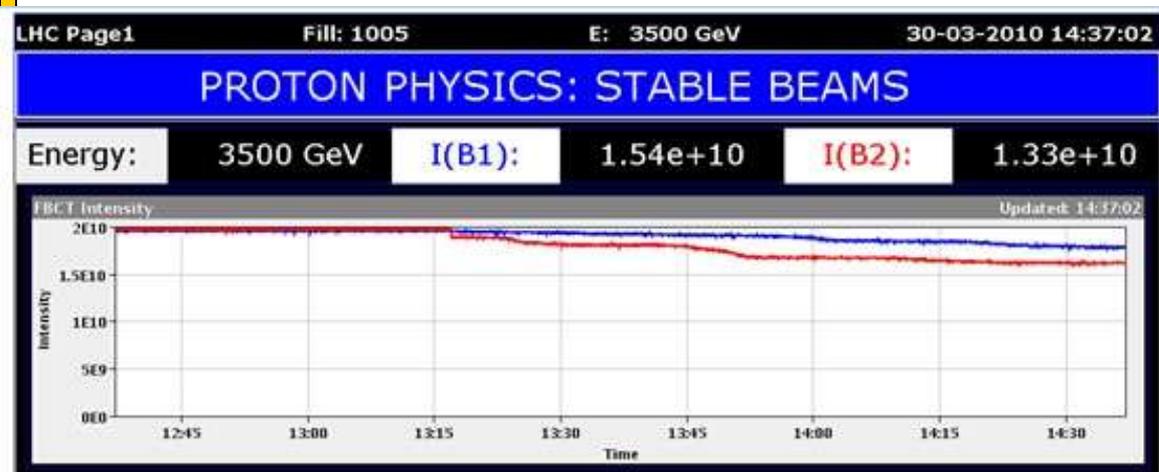
Comments 30-03-2010 14:36:55 :
More than 1h of stable beams!
No black holes
...yet

Collision Event at 7 TeV

ATLAS EXPERIMENT
2010-03-30, 12:58 CEST
Run 152166, Event 316199
http://atlas.web.cern.ch/Atlas/public/EVTDISPLAY/events.html

last_transfer_time - first_transfer_time for BEIJING, updated: 2010-04-06 22:50:43

hp_BEIJING
Entries 69
Mean 2.697
RMS 7.111
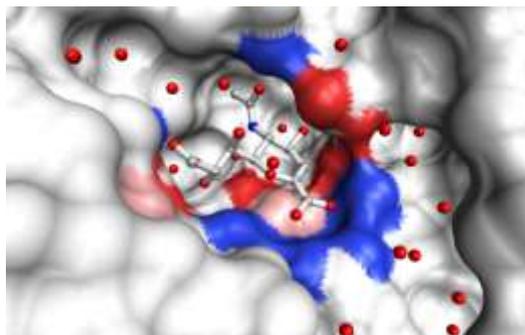Overflow 0

Data at Beijing 2.7 h after
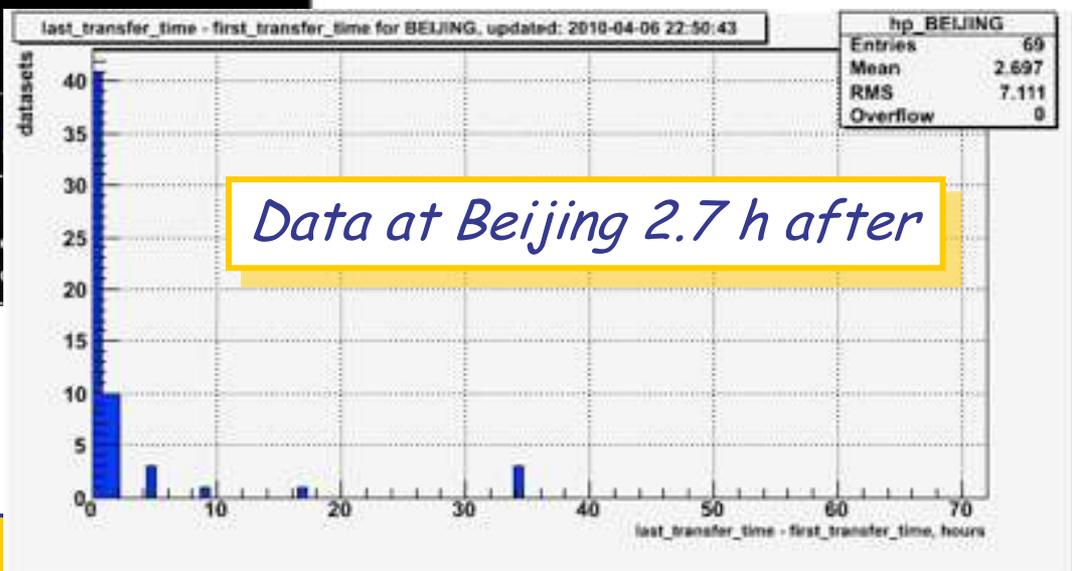
Biomedical application: Avian Flu

Millions of chemical compounds available in laboratories

High Throughput Screening
2$/compound, <u>nearly impossible</u>

300,000 Chemical compounds: ZINC
Chemical combinatorial library

Target (PDB) :
Neuraminidase (8 structures)

eGee
Enabling Grids
for E-sciencE

Molecular docking (Autodock)
~100 CPU years, 600 GB data

Data challenge on EGEE grid
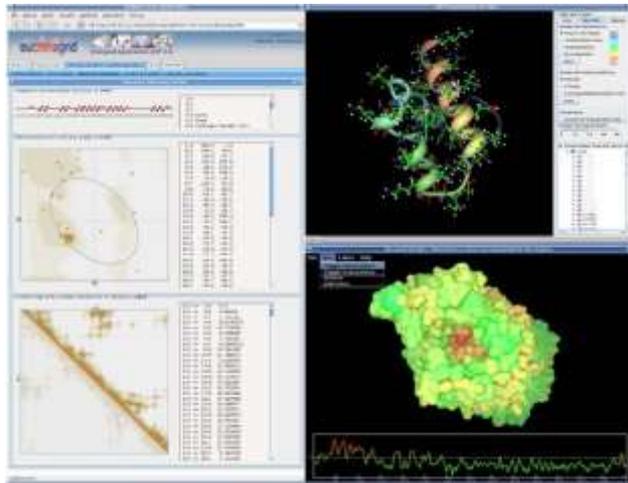~6 weeks on ~2000 computers

Hits sorting
and refining

In-vitro screening of 100 hits

Biological application: protein prodiction

- Explore the non natural protein sequence space
- Set up a massive protein structure prediction environment
- Develop web tools for the biology community
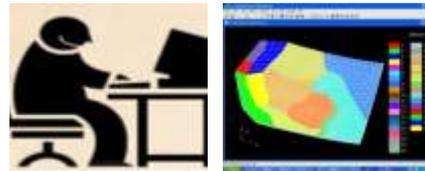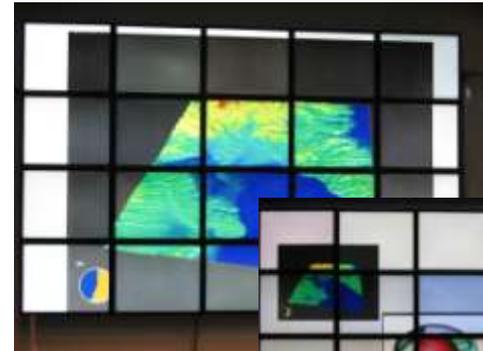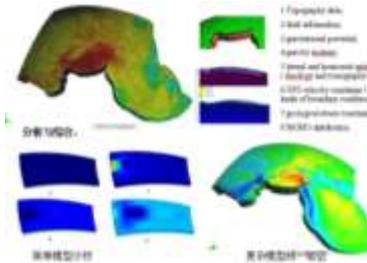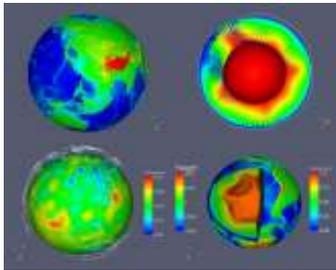- Result of EUChinaGrid project (EU FP6 project)

KWCWPFASHNDLKVQSQ
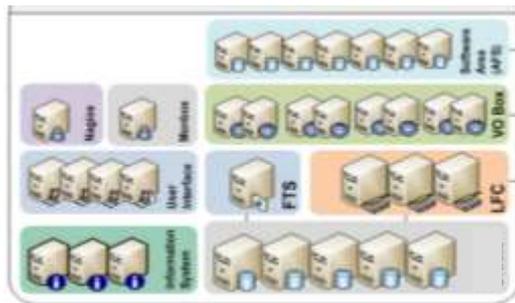*WYVEPPDTIPPYNKYGTN*
FIKHCQYIAHMQGDTHFF
NRVRMHQLWKIIVDCAY

Rosetta

Early/Late Stage
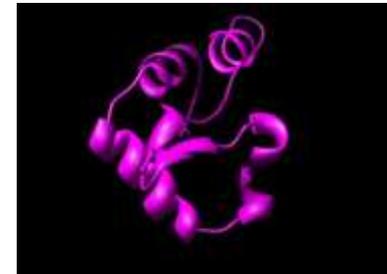
Geodynamics

Visualization

IHEP: Data processing

1Gb/s FC

GUCAS: analysis
(Graduated School of CAS)

Collaboration with HKU

- **IHEP highly regards HKU as an important partner of BESIII collaboration**

- **Grid computing is an essential tool to facilitate the physics researches for scientists from HKU and IHEP**

- **HKU Grid Point is operational just in time!**

- **PAST:**

- **In 2008 and 2009, HKU, CNIC and IHEP worked together to establish the direct network link between CSTNET and HKU**
  - **Key infrastructure of Grid computing**
  - **Special thanks to Prof. Chi, Dr. Kwan, …, and many other colleagues from HKU and CNIC.**

Collaboration with HKU

- <u>NOW:</u>

- A grid portal for BESIII computing on CNGrid is being developed at IHEP

- BESIII software will be deployed on GOS

- Technical details are going to be discussed this afternoon…

- <u>FUTURE:</u>

- Looking forward to closer collaborations with HKU

- And, I am sure we will have a bright future!

Thank You