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
  - $(3\sim10) \times 10^{32}$ 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 need 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

- IHEP
- PKU
- SDU
- USTC
- NJU
Tier-2 site at IHEP

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

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<td>1,501</td>
<td>1,321,412</td>
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<td>Percentage</td>
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<td>62.36%</td>
<td>0.02%</td>
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Physics Simulation

\[ H_{\text{SUSY}} \rightarrow \mu^+ \mu^- \]

- BR \approx 3 \times 10^{-4}
- In MSSM, cross section enhanced relative to SM at large \( \tan \beta \)
- Selection:
  - two muons: \( p_T^\mu > 10 \text{ GeV}, |\eta^\mu| < 2.4 \)
  - \( \leq 1 \text{ jet with } E_T > 40 \text{ GeV in } |\eta| < 2.4 \)
ATLAS MC Study

Pt>20 GeV/c Tracks

ttH-2L selection

ttH(2\ell2b4j2\nu) full simulation event display

ttbar mimic to ttHWW
LHC First Physics

Data at Beijing 2.7 h after
Biomedical application: Avian Flu

Millions of chemical compounds available in laboratories

300,000 Chemical compounds: ZINC
Chemical combinatorial library

Target (PDB): Neuraminidase (8 structures)

High Throughput Screening
2$/compound, nearly impossible

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 prediction

- 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)
Geodynamics

IHEP: Data processing

GUCAS: analysis
(Graduated School of CAS)

Visualization

1Gb/s FC
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

**NOW:**

- 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...

**FUTURE:**

- Looking forward to closer collaborations with HKU
- And, I am sure we will have a bright future!
Thank You