Some Experience with GRID Technologies at St.Petersburg State University

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CONTENT:

1. Introduction
2. Installation and tests of the available software
3. Applications
4. Education of students
5. Plans for ENLIGHT++ and NorduGrid
SPbSU Informational-computing centers
External net - channels

1357 компьютеров, 68 серверов, 62 локальных сети

1272+600 компьютеров, 75 серверов, 132 локальная сеть
Some major scientific and communication links of St. Petersburg State University

- PNPI (Gatchina),
- Institute for High Performance Computing and Information Systems (IHPC&IS, St. Petersburg)
- JINR (Dubna)
- Moscow State University
- ALICE collaboration at CERN since 1992
- NorduGrid since 2004
- RDIG – since December 2005
Current main direction of physics research of SPbSU/ALICE team

Theoretical and experimental aspects of ultra-relativistic collisions of heavy ions: phenomenon of color string fusion (see ALICE Physics Program - ALICE PPR, vol.2, dec.2005)
INSTRUMENTS

Codes for analysis of experimental data for ALICE at the LHC and NA49, NA49-future and NA57 experiments at the SPS (developed or modified at the SPbSU in 2001-2005):

- String Fusion Model (SFM),
- MC Modified Glauber Model (MGM),
- MultiPomeronExchange model with collectivity (MPEM),
- Parton String Model (PSM) event generator in parallel mode
- Long-Range Correlations analysis codes
Installation and tests of the available software

- 1999 – os freeBSD 3.3
- 2000 – OPEN PBS as users job scheduling system
- 2000-2001 – os redHat 6.2, systems of the quantum-chemistry calculations: CRYSTAL 95 and GAMESS
- 2001-2006 design and development of the Portal of the High Performance Computing (WEBWorkSpace, 2005 – expirement with GRIDSphere)
- 2002 – the first cluster for studies of grid-technologies and grid-applications (experiment with globus 2.4)
- 2003 - participation in the AliEn project
- 2004 - participation in the ALICE data challenge
- 2004 – NorduGrid start at SPb (NGN)
- 2005 – LCG and RDIG
- 2006 - participation in Service Challenge (SC4 tests)
- 2006 – Start of work with ROOT/AliRoot on the NorduGrid
Early monitoring picture: AliEn - 2004
Cluster Alice at St. Petersburg State University:

- In 2004-2005 **both AliEn and NorduGrid were running in parallel** at the same SPbSU cluster
  - (see report by A. Zarochentsev at the NGN-4 Workshop in St. Petersburg).
- In the end-of 2005 the **LCG was added** to the same cluster
- **In 2006 we had to separate** the NorduGrid applications a the LCG due to the tough requirements of SC4 tests
Monitoring of the cluster Alice from various sites

NorduGrid job summary for 2006

The total number of submitted jobs contains jobs that were canceled by the user.

<table>
<thead>
<tr>
<th>Number of jobs allowed to run</th>
<th>365</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good jobs</td>
<td>361</td>
</tr>
</tbody>
</table>
MonALISA monitoring
ALICE jobs running at the SPbSU cluster in May 2006
Applications

Some Physical tasks in GRID environment running at cluster Alice

• running of the tests jobs for ALICE
• Parton String Model (PSM) – MC event generator in parallel mode
• Modified Glauber Model
Education of students

GRID education at SPbSU:

Lecture course on C++/ROOT
Lecture course on Grid
NorduGRID tutorial

Education of students aimed at the preparations towards the analysis of experimental data in the ALICE experiment at the LHC, popularization of GRID. Participation in the NordicGrid Neighbourhood programme;
Concept of ALICE computing courses at SPbSU Laboratory for Ultra-High Energy Physics

**Practical courses**
- OS Linux
- Object-oriented programming, C++
- ROOT/AliROOT
- Alice data processing
- NorduGRID/ARC tutorial

**Lectures**
- High performance computing and GRID for high energy physics

**Physics project**
- GRIDification
- Execution
- Final results
The 1\textsuperscript{st} PhD, MS and BS theses and diplomas based on ROOT/GRID

- 1) A.C. Иванов, «Поиск нетривиальных эффектов в столкновениях релятивистских тяжелых ионов на основе модифицированной модели Глаубера» (магистерская диссертация, февраль 2006).
- 2) Науменко П.А. «Обработка и визуализация физических данных с помощью программных комплексов BARSIC и ROOT». Диссертация на соискание ученой степени кандидата физико-математических наук. СПб.: СПбГУ, рук., 2006. 110 с.
- 3) М.В. Норенберг «Анализ флуктуаций заряда и дальних корреляций в Pb+Pb столкновениях при энергии 158 A ГэВ в эксперименте NA49», (бакалаврская дипломная работа, С.Петербург, Июнь 2006)
Plans for ENLIGHT++
and NorduGrid

http://enlight.cern.ch
Europe is moving towards the network of hadrontherapy Centres with proton and $^{12}$C beams. The first ones (Heidelberg and Pavia) will start patient treatments in the year 2007

- Centers under construction in Europe:
  - HICAT, (Heidelberg, Germany)
  - CNAO = Centro Nazionale di Adroterapia for p and $^{12}$C, (Pavia, Italy)
  - ETOILE (Lyon, France)
  - MedAustron (Austria)
- Centers Planned:
  - NordicLight: Centre of Excellence for Light Ion Therapy in Stockholm, Sweden
Protons and carbon ions are charged

- Bragg peak
- Pencil beam
Healthy tissues are spared!
ENLIGHT++ Proposals:

WorkPackage-7 (Information and Communication Technologies Infrastructures for Hadron Therapy)

24/03/2006, see http://enlight.cern.ch

General coordination is done by CERN

- H.F. Hoffmann, CERN: ICT- Infrastructure for Hadron Therapy
- Richard McClatchey, MammoGrid, Health-e-Child Projects, UWE, Bristol
- G. Feofilov St. Petersburg, F. Ould-Saada(NordugGrid): Development of the GRID framework for hadron therapy simulations and advanced treatment planning
Advanced treatment planning requirements:

• Basic physics of interaction of high energy hadrons with matter (MC event generators – GEANT 3 and GEANT 4, FLUKA…, fragmentation process, in-beam PET tomography and irradiation control…)
• Distributed data bases: experimental and simulated results
• Verification of simulations
• Detailed patient tomographic and other diagnostic data
• *Real time as well as time of flight based tomographic reconstruction* A real time reconstruction of in-beam PET data is highly desirable. The reconstruction problem for in-beam PET is aggravated by the limited angle geometry of the PET scanner and the low counting statistics. This forces iterative reconstruction algorithms to be applied, which usually require considerable resources in computing time and memory.
• 3D and 4D simulations (treatment of moving organs) ……

**All these tasks will require considerable resources in computing time and memory. Besides this, the scientific cooperation is essential at all stages.**
• → GRID!
What is needed for the ENLIGHT++ and what could be developed in the NorduGrid:

1. Distributed storage system for large amount of medical images
2. Authorized remote access
3. Catalogization of metadata associated with images
4. Searching of images through metadata
   the 1st prototype of medical images library, see: http://www.fys.uio.no/epf/nordic-network/xi/talks/GRID_in_SPbSU_OSLO-05.ppt
5. Computing resources for the MonteCarlo medical simulations (treatment planning, verification)
Summary

• Alien, ARC and LCG were successfully tested at the SPbSU.
• We have started preparation of students for future ALICE data analysis (C++,ROOT,AliROOT,GRID)
• A number of HEP applications that require GRIDification was developed at SPbSU (SFM,PSM,MGM,MPEM…)
• New applications of GRID for hadron therapy centers (NLIGHT++) are proposed.
Our future

• See the next slide

THANK YOU!
GRID for students of departments of High Energy Physics and of Computational Physics of SPbSU (April 2006)
BACK-UP SLIDES
St. Petersburg State University today

- See http://www.spbu.ru/e/
- 20 faculties
- 11 scientific institutes
- Academical School
- Over 25,000 students
- Over 2,000 postgraduate students
- About 5,000 lecturers and researchers
SPbSU Informational-communication center in Petrodvorets
External net - channels
Cluster Alice in 2006, preparations for the LCG.

- alice.spbu.ru
  - CPU 700MHz
  - RAM 512MB

- alice02.spbu.ru
  - CPU 2x600MHz
  - RAM 1024MB

- alice03.spbu.ru
  - CPU 2x600MHz
  - RAM 1024MB

- alice05.spbu.ru
  - CPU 2x600MHz
  - RAM 1024MB

- alice08.spbu.ru
  - CPU 2x600MHz
  - RAM 1024MB

- alice09.spbu.ru
  - CPU 1400MHz
  - RAM 512MB
  - HDD 1 TB

- alice11.spbu.ru
  - CPU 2226MHz
  - RAM 1024MB

- alice01.spbu.ru
  - CPU 2x600MHz
  - RAM 512MB

- alice07.spbu.ru
  - CPU 2x600MHz
  - RAM 1024MB

- DPM-SE
- RGMA
- VO-BOX (alice)
- LFC
- CE
Cluster Alice in October 2005.

- alice.spbu.ru
  - CPU 700MHz
  - RAM 512MB

- alice02.spbu.ru
  - CPU 2x600MHz
  - RAM 1024MB

- alice03.spbu.ru
  - CPU 2x600MHz
  - RAM 1024MB

- alice05.spbu.ru
  - CPU 2x600MHz
  - RAM 1024MB

- alice08.spbu.ru
  - CPU 2x600MHz
  - RAM 1024MB

- alice09.spbu.ru
  - CPU 1000MHz
  - RAM 512MB
  - 275 GB

- alice01.spbu.ru
  - CPU 2x600MHz
  - RAM 512MB

Connections:
- AliEn 2
- NorduGrid
- LCG SE
<table>
<thead>
<tr>
<th>Country</th>
<th>Site</th>
<th>CPUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia</td>
<td>NorduNode in IHPCIS S&gt;</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>The SPbSU First Clust&gt;</td>
<td>1</td>
</tr>
</tbody>
</table>

One machine at SPbSU
nordugrid.spbu.ru
Example of one ALICE event (PbPb central collision)
What is ENLIGHT++?
European Network for Hadron Therapy
http://enlight.cern.ch

The magic ion 12C!

Example of 3D treatment planning (left):
EXAMPLE: Long-range correlations as a method to discover string fusion phenomenon. Correlation $<p_t>-Nch$ min.bias (ROOT – based analysis of NA49 data)
Some Physical tasks: Some external jobs running at alice/ngn cluster in 2006:

- ALICE tasks
- One example of application in NorduGrid

From: Olav Syljuåsen <sylju@nordita.dk>

The theme lies in the field of condensed matter physics and the concrete goal is to look for phase transitions in model systems describing exotic materials.
Concept of ALICE computing courses at SPbSU started in spring 2006

• Preparation towards ALICE data analyses and ALICE physics
• From physics ideas \(\rightarrow\) towards the GRID

ALICE data analysis and calculations

• Physics idea
• Linux
• Computational physics, C++
• ROOT, AliRoot
• GRID (ARC, LCG)
• Physical result
Fighting cancer: European Hadron Therapy Centers

http://enlight.cern.ch

- centers in operation
- centers planned or under construction
- technology partners

(a picture by MedAustron)