DFH-IFIN ALICE Romanian Branch Progress Report

- ALICE-TRD construction, tests, installation, operation
- Computing activities – hardware & software – AliEn
- Physics
- Financial aspects
- Outlook
• ALICE-TRD construction, tests, installation, operation
Solenoid magnet 0.5 T

Cosmic rays trigger

Forward detectors:
- PMD
- FMD, T0, V0, ZDC

Specialized detectors:
- HMPID
- PHOS

Central tracking system:
- ITS
- TPC
- TRD
- TOF

MUON Spectrometer:
- absorbers
- tracking stations
- trigger chambers
- dipole
OVERVIEW OF THE PARTICIPATION OF COUNTRIES IN THE ALICE DETECTOR CONSTRUCTION

Acorde: Mexico
HMPID: CERN, Croatia, Italy & Russia

TPC: CERN, Croatia, Denmark, Germany, Poland, Slovak Rep. & Sweden

Dipole Magnet: CERN, France & Russia
Muon Tracking: Armenia France, India, Italy & Russia

Muon Trigger: France & Italy

ZDC: Italy
not visible, installed next to the beampipe inside the LHC tunnel.

PMD: India

FMD: Denmark & Russia
T0: Finland & Russia
V0: France & Mexico

PHOS: China, Czech Rep., France, Norway, Poland & Russia

TRD: Germany, Russia JINR & Romania

Muon Absorbers: CERN, France & Russia

TOF: Italy & Russia

ITs Pixel: CERN, Italy & Slovak Rep.
ITs Drift: Czech Rep., Italy, Russia, Ukraine & USA
ITs Strip: CERN, Finland, France, Italy, Netherlands, Russia & Ukraine

DAQ: CERN, Germany, Hungary, Norway and United Kingdom

HLT: Germany & Norway

Trigger: Slovak Rep. & United Kingdom

Computing: Armenia, CERN, Cuba, Italy, Slovakia, Poland and Korea

* according to the Memorandum of Understanding for Collaboration in the Construction of the ALICE Detector (RRB-D-00-41) and to the addendum to the Memorandum of Understanding for Maintenance and Operation of the ALICE Detector CORE Computing.
TRD – sub detector

Purpose:
- electron ID in central barrel p>1GeV/c

Parameters:
- 18 supermodules segmented in 6 layers, 5 stacks
- 540 modules – 750m²
- Length: 7m
- X/X₀ – 15%
- 28 m³ Xe/CO₂ (85:15)
- 1.2 million channels
- 15 TE/s on-detector bandwidth
DFH(NIHAM) – DetLab activities
Chamber tests

- wire tension measurement
- dark current
- gain uniformity
- $^{55}$Fe energy resolution
- finer scanning of the gain uniformity across anode wires
- Oxygen content in normal operation mode
**Under pressure leak rate tests**

- Measurement of the $O_2$ content in gas mixture
- @ 2 mbar under pressure, 20 l/h gas flow
- 29 chambers tested
- The average leak rate - 2.7 l/h

<table>
<thead>
<tr>
<th>No.</th>
<th>Chamber</th>
<th>$O_2$ (ppm)</th>
<th>Leak rate (l/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>L3C1#62</td>
<td>45</td>
<td>2.25</td>
</tr>
<tr>
<td>2.</td>
<td>L3C1#60</td>
<td>54.4</td>
<td>2.72</td>
</tr>
<tr>
<td>3.</td>
<td>L3C1#37</td>
<td>57.9</td>
<td>2.9</td>
</tr>
<tr>
<td>4.</td>
<td>L3C1#57</td>
<td>58</td>
<td>2.9</td>
</tr>
<tr>
<td>5.</td>
<td>L3C1#52</td>
<td>44.4</td>
<td>2.22</td>
</tr>
<tr>
<td>6.</td>
<td>L3C1#38</td>
<td>49</td>
<td>2.45</td>
</tr>
<tr>
<td>7.</td>
<td>L3C1#50</td>
<td>58</td>
<td>2.90</td>
</tr>
<tr>
<td>8.</td>
<td>L3C1#59</td>
<td>52.6</td>
<td>2.63</td>
</tr>
<tr>
<td>9.</td>
<td>L3C1#43</td>
<td>58.6</td>
<td>2.93</td>
</tr>
<tr>
<td>10.</td>
<td>L3C1#39</td>
<td>50.1</td>
<td>2.5</td>
</tr>
<tr>
<td>11.</td>
<td>L2C1#69</td>
<td>54</td>
<td>2.7</td>
</tr>
<tr>
<td>12.</td>
<td>L2C1#65</td>
<td>50.1</td>
<td>2.5</td>
</tr>
<tr>
<td>13.</td>
<td>L2C1#67</td>
<td>49.5</td>
<td>2.48</td>
</tr>
<tr>
<td>14.</td>
<td>L3C1#41</td>
<td>45.9</td>
<td>2.3</td>
</tr>
<tr>
<td>15.</td>
<td>L3C1#24</td>
<td>49.3</td>
<td>2.47</td>
</tr>
<tr>
<td>16.</td>
<td>L3C1#40</td>
<td>55.5</td>
<td>2.78</td>
</tr>
<tr>
<td>17.</td>
<td>L3C1#66</td>
<td>48.2</td>
<td>2.41</td>
</tr>
<tr>
<td>18.</td>
<td>L3C1#58</td>
<td>50.4</td>
<td>2.52</td>
</tr>
<tr>
<td>19.</td>
<td>L3C1#61</td>
<td>50.7</td>
<td>2.54</td>
</tr>
<tr>
<td>20.</td>
<td>L3C1#54</td>
<td>58.7</td>
<td>2.94</td>
</tr>
</tbody>
</table>
ROC Production planning (March, 30th 2007)

Status (3/2007)

<table>
<thead>
<tr>
<th>Chamber</th>
<th>Finished</th>
<th>To be Done</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bucharest</td>
<td>67</td>
<td>41</td>
<td>108</td>
</tr>
<tr>
<td>Dubna</td>
<td>91</td>
<td>14</td>
<td>103</td>
</tr>
<tr>
<td>Frankfurt</td>
<td>27</td>
<td>44</td>
<td>71</td>
</tr>
<tr>
<td>GSI</td>
<td>68</td>
<td>78</td>
<td>146</td>
</tr>
<tr>
<td>Heidelberg</td>
<td>39</td>
<td>46</td>
<td>85</td>
</tr>
</tbody>
</table>

Further Production:

<table>
<thead>
<tr>
<th>Type</th>
<th># to be done</th>
<th>Lab</th>
<th># prod at Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>LxC0</td>
<td>14</td>
<td>Dubna</td>
<td>all</td>
</tr>
<tr>
<td>L0C1</td>
<td>44</td>
<td>Frankfurt</td>
<td>all</td>
</tr>
<tr>
<td>L1C1</td>
<td>46</td>
<td>Heidelberg</td>
<td>all</td>
</tr>
<tr>
<td>L2C1</td>
<td>42</td>
<td>Bucharest</td>
<td>20</td>
</tr>
<tr>
<td>L3C1</td>
<td>42</td>
<td>Bucharest</td>
<td>20</td>
</tr>
<tr>
<td>L4C1</td>
<td>39</td>
<td>GSI</td>
<td>all</td>
</tr>
<tr>
<td>L5C1</td>
<td>39</td>
<td>GSI</td>
<td>all</td>
</tr>
</tbody>
</table>

Timescale estimate:
(assuming 4 weeks Summer vacation, 2 weeks Christmas vacation)

<table>
<thead>
<tr>
<th>Lab</th>
<th>Duration (weeks)</th>
<th>End of prod</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bucharest</td>
<td>41</td>
<td>3/ 2008</td>
</tr>
<tr>
<td>Frankfurt</td>
<td>63</td>
<td>7-8/ 2008</td>
</tr>
<tr>
<td>GSI</td>
<td>65</td>
<td>7-8/ 2008</td>
</tr>
<tr>
<td>Heidelberg</td>
<td>92</td>
<td>2/ 2009</td>
</tr>
</tbody>
</table>

Production rates (historical average):

<table>
<thead>
<tr>
<th>Chamber</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bucharest</td>
<td>1 ch/week</td>
</tr>
<tr>
<td>Dubna</td>
<td>1 ch/week</td>
</tr>
<tr>
<td>Frankfurt</td>
<td>0.7 ch/week</td>
</tr>
<tr>
<td>GSI</td>
<td>1.2 ch/week</td>
</tr>
<tr>
<td>Heidelberg</td>
<td>0.5 ch/week</td>
</tr>
</tbody>
</table>

+44 chambers which are not included, leading to additional ~44 production weeks.
# Construction Status – 06.06.08

<table>
<thead>
<tr>
<th>Status</th>
<th>Bucharest 03.06.2008</th>
<th>Dubna 06.06.2008</th>
<th>Frankfurt 03.06.2008</th>
<th>GSI 06.06.2008</th>
<th>Heidelberg 05.06.2008</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>wired frames</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>taped</td>
<td>7</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>3</td>
<td>21</td>
</tr>
<tr>
<td>tested taped</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>glued (tests not completed)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>finished</td>
<td>108</td>
<td>104</td>
<td>40</td>
<td>127</td>
<td>58</td>
<td>437</td>
</tr>
<tr>
<td>to be repaired</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

Total chambers wired and beyond: 484, 87%

Chambers wired and beyond 09.07.2007:

<table>
<thead>
<tr>
<th></th>
<th>Bucharest</th>
<th>Dubna</th>
<th>Frankfurt</th>
<th>GSI</th>
<th>Heidelberg</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>79</td>
<td>95</td>
<td>34</td>
<td>85</td>
<td>49</td>
<td>342</td>
</tr>
</tbody>
</table>

Apparent momentary production rate (chambers/week): 3.16

Needed production rate: 8.88

484 out of 540 + 15 (spares) are in production, an overall of 87%

Extrapolation: \( \frac{555 - 484}{3.2 \text{ ch/week}} = 22 \text{ weeks i.e. mid Nov. 2008} \)
Present status

- 12 taped chambers
- 3 pad planes
- 4 frame + radiator

⇒ ~ Aug – Sept 2008 – the extra 22 chambers ready
Chambers transport

108 chambers finished

Delivery date:
- May 2005 - 7 chambers
- Mar 2006 - 25 chambers
- Nov 2006 - 25 chambers
- Nov 2007 - 20 chambers
- May 2008 - 28 chambers

TOTAL: 105 chambers sent to GSI - Darmstadt
TRD SM – in beam tests
TRD SM – in beam tests
TRD SM – in beam tests
TRD SM – in beam tests
TRD SM – in beam tests
TRD SM – installation
TRD SM – installation
ALICE TRD operation
Cosmics
ALICE TRD operation

Cosmics

SM08

SM00

SM09

SM17
• Computing activities – hardware & software – AliEn
November 2002, the first international GRID application in Romania within AliEn

DRACULA Workgroup Network

EP-824-DX-CS Fast Ethernet Switch
(24 x 10/100 Mbps)

DSnah

AT-8224XL TANDEM Backbone Switch
(24 x 10/100 Mbps)
(2 x 100BaseFX)

DRACULA
alex1
alex2
alex3

poseidon

Mosix Cluster
alice.nipne.ro – Pentium II 300MHz, 128MB RAM
Linux-Mosix
alice1.nipne.ro – Pentium III 800MHz, 512MB RAM
Linux-Mosix
alice2.nipne.ro – AMD Athlon XP 1.53GHz, 1 GB RAM
Linux-Mosix
poseidon.nipne.ro – Pentium II 333MHz, 128MB RAM
Linux-Mosix
dracula.nipne.ro – Pentium II 300MHz, 128MB RAM
Linux-Mosix
alex.nipne.ro – AMD Athlon XP 1.53GHz, 1 GB RAM
Linux-Mosix
alex2.nipne.ro – Pentium II 300MHz, 128MB RAM
Linux-Mosix
alex3.nipne.ro – PentiumPro 200MHz, 64MB RAM
Linux-Mosix

Connection keys:
-----------------------------
100 Mbps copper
-----------------------------
100 Mbps fiber
-----------------------------
10 Mbps copper

CPU – 330 Si95
Disk Storage 350 GB
7 hours for a full Central Event (HIJING + GEANT)

M. Petrovici et al, Int. GRID Workshop, April 2002, Bucharest
The first production cluster, 1 frontend machine (dual Xeon 3GHz, 2GB RAM, 2.4 TB raw HDD), 6 nodes (dual Xeon 3GHz, 4GB RAM) another 4 at the end of the year, all server-class, 32bit

1 Gb/s network

Placed in the NIHAM Detector Laboratory, cooled by the Lab's unit

Among the first AliEn2 sites (May-June 2005, C. Schiaua)

In production since September 2005

838 jobs done

C. Andrei et al, Int. GRID School, 2005, Varna
2006 - takeoff

- 40 new machines deployed during the year (dual Xeon 3.2 Ghz, 2 MB L2, 4GB RAM)
- EGEE site (C. Aiftimieie, C. Schiaua)

Policy:

- “Regarding GRID, there is nothing more important than having a running and used site”

- Exploit to the maximum extent the “dedicated” character of the site in order to achieve high stability and availability

- Try to find as fast as possible solutions for the problems showing up during production

C. Schiaua, invited talk, International GRID Workshop, Sinaia 2006
2006 - takeoff

- ~33500 jobs DONE
- ~360 kHours CPUTime
- ~7% of ALICE

Starting with September 2006, NIHAM Storage Element was used by ALICE production jobs to store log files
NIHAM Data Centre
Tier 2 → Tier 1

Present status

~ 700 CPU cores, 2GB RAM/core
- 144 TB (raw) dedicated storage
- 1 Gbit/s internal network
- 10 Gbit/s uplink
- 3 cooling units, industrial grade
- 3 x 80 kVA UPS, industrial grade
- Diesel generator, 600 kVA
- ~900 kSI2k CPUs.
- ~120 TB effective disk storage (xroott).
- ALICE-dedicated, mostly AliEn-only.
- ~2.3 kSI2k Mhours (~260 kSI2k years) delivered in the last 2 years.
- ~7.3 million files written on NIHAM storage in the last 2 years.
- ~5% of ALICE.
- > 97% availability.
NAF – NIHAM Analysis Facility

- 16 nodes, 128 CPU cores, 2GB RAM/core, 800 GB storage/node
- PROOF cluster
- Batch system
- Dedicated to local analysis, both batch-like and parallel
Physics
ALICE Physics & Offline Analysis

~ 2 NIHAM PWG meetings/week
Collective phenomena in heavy ion collisions

May nucleus-nucleus collisions probe the physics of this epoch?

Why Flow?
- Properties of the initial phase
- Information on:
  - In-medium effects
  - Equation of State
  - Phase transitions

The Planck epoch

Quark-hadron transition

$\frac{t}{T} = 10^{-6}$ sec
$T = 1$ GeV
$v_2$ excitation function
**Elliptic Flow - Quark Number Scaling**

- At the moment of hadronization in nucleus-nucleus collisions at RHIC the dominant degree of freedom is related to number of constituent (valence) quarks.

- These 'constituent quarks' exhibit an angular anisotropy resulting from collective interactions.

- Hadrons seem to be formed from coalescence or recombination of the 'constituent quarks.'
Other effects to be considered

**Hadronic dissipative effects**
- T. Hirano et al, nucl-th/0608033

**Angular momentum conservation**
- F. Becattini et al, nucl-th/0711.1253

**Core – Corona effects**
- K. Werner, PRL 98(2007)152301

**Pb+Pb**
- 17.3 GeV

**Participant number** $N_p$
Highly central collisions

- Au+Au
- Xe+CsI
- Ni+Ni

- open: $20^\circ < \theta_{cm} < 35^\circ$
- full: $80^\circ < \theta_{cm} < 100^\circ$
Transverse Flow

$\langle \beta_r \rangle$ [c]

$T_{th}$ [GeV]

$\sqrt{s_{NN}}$ (GeV)

Au(Pb) + Au(Pb) Central Collisions

Bevatron SIS AGS SPS RHIC
Transverse Flow

\[ \beta = 0.53 \pm 0.01 \]
\[ T = 112 \pm 1 \text{ MeV} \]

\[ \Lambda, \ \bar{\Lambda}, \ \Xi^+, \ \Omega^-, \ J/\psi \]
\[ \beta = 0.36, \ T = 172 \text{ MeV} \]

\[ \pi, \ K, \ \bar{p}, \ d, \ \bar{d} \]
\[ \beta = 0.59, \ T = 104 \text{ MeV} \]
### Past-Present-Future

<table>
<thead>
<tr>
<th></th>
<th>SPS</th>
<th>RHIC</th>
<th>LHC</th>
<th>LHC:</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sqrt{s_{NN}}$ (GeV)</td>
<td>17</td>
<td>200</td>
<td>5500</td>
<td></td>
</tr>
<tr>
<td>$dN_{ch}/dy$</td>
<td>500</td>
<td>850</td>
<td>1500-4000</td>
<td></td>
</tr>
<tr>
<td>$t_Q^{0}$ (fm/c)</td>
<td>1</td>
<td>0.2</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>T/T_c</td>
<td>1.1</td>
<td>1.9</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>$e$ (GeV/fm$^3$)</td>
<td>3</td>
<td>5</td>
<td>15-60</td>
<td></td>
</tr>
<tr>
<td>$t_Q$ (fm/c)</td>
<td>≤2</td>
<td>2-4</td>
<td>≥10</td>
<td></td>
</tr>
<tr>
<td>$t_r$ (fm/c)</td>
<td>~10</td>
<td>20-30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_r$ (fm$^3$)</td>
<td>few $10^3$</td>
<td>few $10^4$</td>
<td>Few $10^5$</td>
<td></td>
</tr>
</tbody>
</table>

**Hotter**

**Denser**

**Longer**

**Bigger**

**LHC**: will open the next chapter in HI physics

**significant step over & above existing facilities**

**THE place to do frontline research soon**
MC analysis

Pb + Pb 5.5 TeV
GeVSim
MC analysis

Pb + Pb 5.5 TeV
Hijing
Results

- Heavy Ion Physics with ALICE - invited talk
  M. Petrovici
  Four Seas Conference, May 2007, Iasi – Romania

- Selected Aspects of Collective Flow in Heavy Ion Collisions - invited talk
  M. Petrovici and A. Pop
  Carpathian Summer School of Physics, Aug.-Sept. 2007, Sinaia-Romania

- NIHAM within ALICE-GRID - invited talk
  M. Petrovici and C. Schiaua
  ICFA Digital Devide Workshop, Mexico City, October 24-27, 2007

- NIHAM ALICE TRD-chambers status – presentation
  M. Petrovici on behalf of DFH-NIPNE ALICE branch
  Hauenstein, Germany, June 6-7, 2008

- Collective phenomena in Heavy Ion Collisions – invited talk
  M. Petrovici, C. Andrei, I. Berceanu, A. Herghelegiu, A. Pop, C. Schiaua
  The 3rd Light Ion Nuclear Collisions Workshop 18-21 June, 2008
  Protvino – Russia

- ALICE – Technical Paper I
  ALICE Collaboration
  CERN, October 2007, published ???

- Cristian Andrei – Master Thesis

- Andrei Herghelegiu – Master Thesis
ALICE Workshop
August 20 - 24
Sibiu 2008

Topics:
- TRD
- AliEn
- Physics

Organizing Committee
F. Antinori
P. Braun-Münzinger
R. Brun
F. Carminati
Ch. Kühn
G. Martinez
A. Morsch
M. Petrovici
L. Ramello
J.P. Revol
K. Safarik
J.P. Schukraft
Y. Schutz
J. Stachel
J. Wessels

Local Organizing Committee
C. Andrei
M.D. Cozma
A. Pop
C. Schiaua

Sponsors
ANCS
CNMP
IFIN-HH

http://niham.nipne.ro/aliceworkshop08

http://niham.nipne.ro/aliceworkshop08
Financial aspects
Financial aspects

The activities of which results were summarized above were financed within the following Programs:

- CEEX
- CORINT NUCINT
- CORINT EU
- CAPACITATI
- PARTENERIATE
- IDEI
- Resurse Umane
- PN

Do we have to continue like this? ⇒ consequences!