An overview of the Experimental High Energy Activities in Greece

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The Activities

Greek Experimental HEP Activities

- Accelerator Experiments
  - PhD's 44
  - PhD-students 30

- Non-Accelerator Experiments
  - PhD's 12
  - PhD-students 4

Detector/Accelerator R&D
- PhD's 3
- PhD-students 2

Accelerator Physics Experiments

- CERN
  - LHC Experiments
    - ATLAS
      - PhD's 18
      - PhD-students 10
    - CMS
      - PhD's 17
      - PhD-students 10
    - ALICE
      - PhD's 3
      - PhD-students 5

- nTOF

Accelerator Physics Activities

- Fermilab Experiments
  - Tevatron-CDF
    - PhD's 1
    - PhD-students 2

- DESY Experiments
  - Neutrino Physics
    - PhD's 1
    - PhD-students 1
  - HERA-H1/ZEUS
    - PhD's 3
    - PhD-students 1

Non-Accelerator Physics Experiments

- Experiments in Greece
  - NESTOR
    - PhD's 4
    - PhD-students 2

- HELYCON
  - PhD's 3
  - PhD-students 2

- CAST
  - PhD's 4
  - PhD-students 2

The Greek ATLAS Project

NKUA, NTUA, AUTh all three institutes collaborated for the construction of the BIS chambers of the ATLAS Muon Spectrometer, consisting of 128 MTD Muon chambers

All chambers installed in the ATLAS pit since Dec 2006

All chambers commissioned with cosmic rays Ready for data taking
The Greek ATLAS Project

- **Muon studies:**
  - DCS and HV/LV, Bfield control for MTD's, Muon Data Quality Assessment software, Cosmic ray runs for the detector commissioning, Muon energy loss in calorimeters, Muon reconstruction performance

- **Physics studies and interests:**
  - Higgs (SM H→4l, H/A→2μ)
  - Exotics (Z’→μμ, W’→μν, Heavy quarkonia, Lepto-Quark)
  - SM diboson production, search for anomalous couplings
  - B physics (B cross-section, B+→J/ΨK+)

CMS in Greece

- **2008: 17 PhD physicists**
  - **Physics studies and interests:**
    - CASTOR: Project management, Construction, Beam tests
  - **Physics analysis:**
    - CMS physics coordination (UoA)
    - Physics analysis of ECAL-Preshower test beam data (DEMONCRITOS, UoA)
    - CASTOR: Design, development and construction of the H.V. Distribution System (HVDS) for the TRD detector.
    - Design and development of a monitoring system (Gate Pulser) for the ALICE TPC.
    - Development of the DAQ monitoring system for the Forward detectors of ALICE - used by all ALICE detectors.
  - **Future plans:** Data Analysis, SLHC

ALICE in Greece

- **Hardware/Software Contributions of the NKUoA to ALICE**
  - Design, development and construction of the H.V. Distribution System (HVDS) for the TRD detector.
  - Design and development of a monitoring system (Gate Pulser) for the ALICE TPC.
  - Development of the DAQ monitoring system for the Forward detectors of ALICE - used by all ALICE detectors.
  - Software development for Data Flow Control for all ALICE detectors (AMORE)

- **Hardware Contributions of the NKUoA to ALICE**
  - A Master/Slave power supply distribution system has been designed and constructed in order to provide the required anode (1.9kV) and drift voltage (-2.5kV) to the ALICE TRD readout chambers.
  - The system can switch on and off, monitor (at the nA level), protect, and regulate (leverage of 1000 Volts) each channel from a common ceiling voltage.

- **TRD Description**
  - HVDS (High Voltage Distribution System): A Master/Slave power supply distribution system designed to provide the required anode voltage (-1.9kV) and drift voltage (-2.5kV) to the TRD readout chambers.
  - The system is capable of switching on and off, monitoring, protecting, and regulating each channel with a leverage of 1000 Volts from a common ceiling voltage.
Hardware Contributions of the NKUoA to ALICE

**HVDS Specifications**

<table>
<thead>
<tr>
<th>Both Systems:</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Channels</td>
<td>180</td>
</tr>
<tr>
<td>ramp-up rate</td>
<td>1-30 V/s</td>
</tr>
<tr>
<td>ramp-down rate</td>
<td>1-100 V/s</td>
</tr>
<tr>
<td>HV stability</td>
<td>&lt;0.1% / 24h</td>
</tr>
<tr>
<td>Achieved HV stability</td>
<td>~0.002% / 24h</td>
</tr>
<tr>
<td>Ripple rejection</td>
<td>~40 dB</td>
</tr>
<tr>
<td>Current accuracy</td>
<td>&lt;0.2%</td>
</tr>
<tr>
<td>Achieved Current accuracy</td>
<td>~0.03%</td>
</tr>
<tr>
<td>response time</td>
<td>&lt; 50 ms</td>
</tr>
</tbody>
</table>

Anode System:
- Dynamical range: 900 - 1900 V
- Max. current: 7 µA

Drift System:
- Dynamical range: 1450 - 2500 V
- Max. current: 270 µA

Contributions to the ALICE Physics Performance Reports (I + II)

- Topological K/π identification
- <PT> studies
- K/π ratio
- Charge fluctuations
- Wavelets method
- Balance Function
- Hadronic Resonances etc.

Contributions to Physics Analysis Software of the NKUoA in ALICE

- Physics preparation Studies with Monte Carlo simulations:
  - Topological K/π identification
  - <PT> studies
  - K/π ratio
  - Charge fluctuations
  - Wavelets method
  - Balance Function
  - Hadronic Resonances etc.

Contributions to Physics Analysis Software of the NKUoA to ALICE

K/π separation from their decays in the TRD detector

Capture measurements
- Mo, Ru, Pu stable isotopes for fission products and isotopes pion in S.C. grains
- Fs, Ru, Zr, and Se stable isotopes for fission products
- A-190 isotopes: 208Tl, 209Bi, 209Pb, 209Bi
- A-190 isotopes: 208Tl, 209Bi, 209Pb, 209Bi
- 232Th nuclear fuel cycle
- Th/U nuclear fuel cycle standards: conventional U/Pb fuel cycle
- Incineration of minor activities

Greek Contribution to nTOF

- Aristotle University of Thessaloniki
- NTUA
- University of Ioannina
- NRCPs Demokritos
- Measurements relevant to fundamental physics:
  - Nuclear Astrophysics
  - Nuclear fuel cycles and incineration of nuclear waste

Accelerator Experiments: FermiLab Tevatron-CDF

- Participation: University of Athens
  - Activity:
    - Top mass measurement
      - Use P_t of lepton to estimate mass
  - W -> ev cross-section measurement
    - Use forward electrons
Greece in CDF

- Lepton $P_T$ spectrum sensitive to the top mass
  - Use maximum likelihood method to fit data with signal + SM background for different top mass values
- Method can be applied to LHC data

A. Stavrinos PhD Thesis

V.Giakoumakopoulou PhD Thesis

University of Athens Neutrino Group (NKUoA)

Activities:
- DONUT Experiment (Completed)
- MINOS Experiment: Far Detector PMT Testing and Characterization, Near Detector Commissioning, CC Data Analysis.
- NOvA Experiment (In construction): Construction of a PET prototype
- N. Saoulidou: DONUT (PhD), MINOS
- C. Andreopoulos: DONUT, MINOS (PhD)

Beam:
- NuMI beam, 120 GeV Protons → $\nu_\mu$ (High Intensity)

Detectors:
- ND, FD
- Near Det: 980 ton version of FD, at FNAL ($L \approx 1$ km):
  - Measure beam composition and energy spectrum
- Far Det: 5.4 kton magnetized Fe/Sci Tracker/Calorimeter at Soudan, MN ($L = 735$ km):
  - Search for evidence of oscillations

Best Fit:
- $|\Delta m^2| = 2.43 \times 10^{-3}$ eV$^2$
- $\sin^2(2\theta) = 1.00$

World’s Best $\Delta m^2$ measurement

The MINOS Experiment

FAR MINOS DETECTOR

NEAR MINOS DETECTOR

MINOS Detector Technology

Objects not to scale
What to Test
- Gain determination (dependence on HV)
- Correlated Non-thermal HV (Gains = 1xLPC)
- Dark count spectra and dark count rates
- Verify good SPE separation
- Cross-talk
- Uniformity
- Linearity
- Using long stability

Total number of tested PMTs for MINOS FAR DETECTOR: 750
HELYCON: Testing and Shower Reconstruction

- Single Station equipped:
  - 4 scint. counters
  - GPS synchr. system
  - PC based DAQ syst.

Zenith angle distribution of reconstructed atmospheric showers (data points) with Monte Carlo (KORISCA, solid line) predictions using:
- a) the detectors A1, A2, A3, B1, B2, B3
- b) the counters A1, A2, A3
- c) using the counters B1, B2, B3

HELYCON: Detector Deployment

- Patras
- Chios
- Nicosia
- Thessalonica

HELYCON: KM3 Neutrino Telescope

- Angular calibration and absolute position
- Search for axions from the sun, detected via their coupling to the magnetic field
- Use the prototype dipole LHC magnet

CAST in Greece

- Participating Institutes:
  - University of Patras
  - NRCPS Democritos
  - Aristotle University of Thessaloniki
  - National Technical University of Athens

- Major Contributions to the Experiment:
  - Strong Greek involvement in the proposal and the creation of the Collaboration
  - Contribution to development, construction and installation of Micromegas detectors
  - Monte Carlo simulations and data Analysis
  - Software development for the He-3 system controls

CAST in Greece

Micromegas for SLHC

A project to investigate the feasibility and determine the working parameters of Micromegas for SLHC tracking

In conjunction with the ATLAS SLHC Micromegas chambers effort

Participating Institutions
- Saclay
- Demokritos
- Univ. of Athens
- Univ. of Thessaloniki
- Technical Univ. of Athens
The Telescope

Detector parameters
- Design and construct 6 (X,Y) detectors to form a beam telescope
- Design and construct several test detectors with different pitches (0.5, 1 and 2 mm)
  some with resistive layers.
- Use GASiPLEX electronics and later a faster front-end system
- Design Labview DAQ and later a faster system

Measurements
- Assessment of protection against sparks
- Improvement of spatial resolution
- Gas mixture studies

Status
- X and Y Micromegas chamber design finished
- 2 prototypes constructed
- 8 more chambers under construction
- Labview DAQ and Monitoring under development
- Planning for initial tests in October 08

LHC Grid Computing
The WLCG Project in Greece
- Six Grid clusters of the Hellas Grid are currently running in Greece
- Approximate 1000 64-bit CPU units and 100 TBytes online storage, connected over an end-
to-end Gigabit backbone
- The HellasGrid infrastructure is fully integrated within the pan-European Grid infrastructure EGEE
- No MoU yet signed with the WLCG