The Aristotle University (AUTH) group in the Marie Curie IAPP FTK project

Kostas KORDAS

Aristotle University of Thessaloniki

Department of Physics

for the Division of Nuclear & Particle Physics

and the Division of Electronics

Project kick-off meeting, University of Pisa, 11-12 March 2013

Two words on the University

- **The Aristotlte University of Thessaloniki (AUTH)**
  - the biggest Greek University with >90k students (undergrads and grads), curing all disciplines (Sciences, Engineering, Medicine, Law, Letters, Philosophy, etc)
  - a pioneer in the dissemination of Science in the broader region of Northern Greece (Macedonia and Thrace), having established the very active Centre, NOESIS, for the Diffusion of Sciences in the Society).
- **The Physics Dept.**
  - has 90 faculty, >1k students, and cures research in Solid State Physics, Nano science, Nuclear and Particle Physics, Astronomy and Astrophysics, Electronics and Computing, and other Applications of Physics (including environmental Physics, antenas, archeometry and measurements on nuclear fallouts).
- **In the IAPP-FTK project, two divisions**
  - Division of Nuclear & Particle Physics (3 faculty, 1 Ph.D candidate)
  - Division of Electronics (1 faculty, 2 Ph.Dcandidates)

1. Division of Nuclear and Particle Physics Composition of the ATLAS Group

Faculty members : 3

- Chara Petridou,
- Dimos Sampsonidis, Kostas Kordas

Technicians : 1 Electronics Technician

PhD students : 5

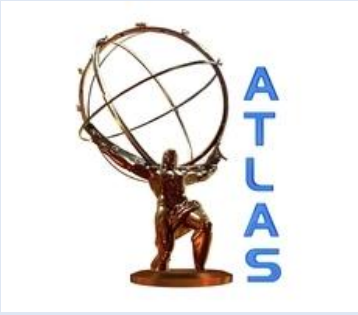
Msc students: 2 (Ourania Sidiropoulou)

Trained Undergrads : 4

Kordas: Trigger & DAQ, central system

Sampsonidis: Grid and track reconstruction

Sidiropoulou: DAQ for muon system

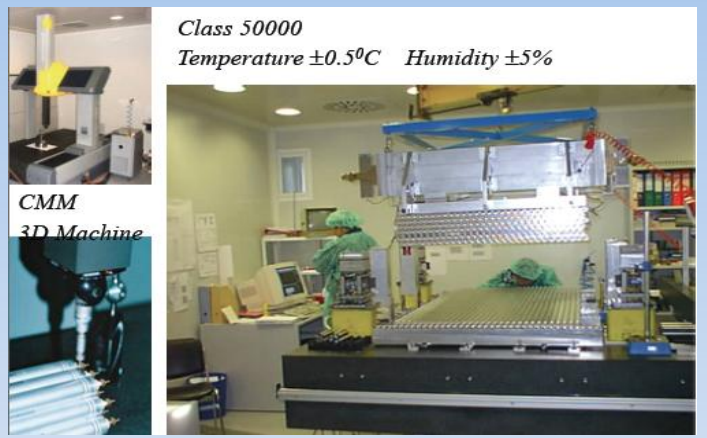


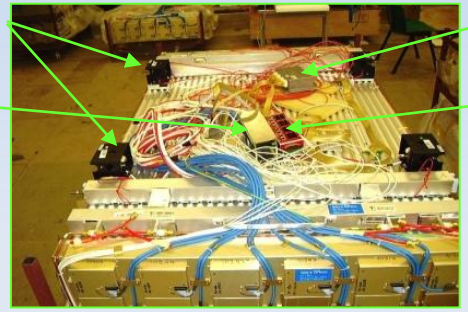
Division of Nuclear and Particle Physics Research Activities of the ATLAS Group

1996 - 2008

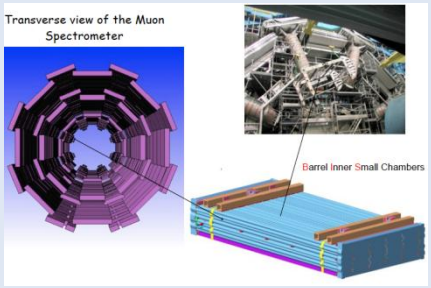
- Joint the ATLAS experiment (1996)
- Establish the Muon chamber construction laboratory (1999)

- Construction and test of the 10% of MDT chambers in ATLAS (Barrel Inner Small) (1999-2003)



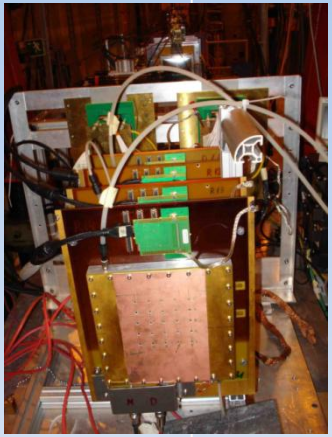


- Installation Commissioning (2003-2006)
- Test beam & Cosmic (2006-2008)



Division of Nuclear and Particle Physics Research Activities of the ATLAS Group

2008-today:



- R&D on the MicroMegas detectors for superLHC
- Participating in RD51 (MicroMegas)
- Participating in the New Small Wheel of ATLAS for the superLHC upgrade

2009-today:

- Physics data analysis
- B-physics topics: differential & total cross section measurements
- Diboson studies with leptons in the final states
  - ZZ→4 leptons, WZ→lllν
    - Triple gauge couplings
    - Search for Exotic states with dibosons

Division of Nuclear and Particle Physics Infrastructure of the ATLAS Group

Clean Room:

- Class 50000, (common with Mech. Eng. Dept. AUTH)
- Granite Table (2.7x2.3x0.4 m^3 7ton), CMM machine

Grid Infrastructure:

- 128 cores, Storage 40TB (Tier-3 for ATLAS AUTH)

Cosmic Test Stand:

- Hodoscope with scintillator setup for triggering
- Read Out Electronics and CAMAC and VME Data Acquisition

Here we'll put the FTK crate

2 BIS MDT Chambers and a MicroMegas prototype:

- for studying the chamber properties and teaching and demonstration purposes
- Gas Aging studies system including alpha particle source
- Gas Mixing and Distribution System
- RASNIK systems (Relative Alignment System NIKhef)

Division of Nuclear and Particle Physics Research Projects of the ATLAS Group

Current Research Projects, funded by the Greek Funding Agency (GSRT) or by the European Union (~2 MEuro past 5years):

- **FTK-IAPP** 2013-2017
- **DIBOSON** project 2011-2015 (EU and Nationally funded : NSRF/ESPA, Thalis action
- **AIDA** project (2011-2015), FP7-INFRASTRUCTURES (on MicroMegas)
- **ARTEMIS**: A Marie-Curie RTN (2006-2010) for physics analysis in ATLAS
- **CROSSGRID** project (IST, 2002-2005) A pilot Grid project
- **EPAN- project** for the certification and installation of the BIS chambers at CERN (2005 – 2008)
- **EPEAK-project** for the construction of the MDT chambers at AUTh (1999-2003)

Division of Nuclear and Particle Physics Infrastructure of the ATLAS Group

Responsibilities in ATLAS, CERN and Reviewers

- ATLAS TDAQ Speakers' Committee
- ATLAS Publications Committee
- Referee in Detector Physics Journals
- Editorial board in ATLAS papers
- ACCU representative

Outreach

- International Particle Physics Masterclasses for High school students (2005 onwards, >120 students trained each year)
- ISOTDAQ school: organized the 4th edition 1-8 Feb. 2013 in AUTH, advisors to all
- Lectures about Particle Physics at High Schools, Colleges and for the general public.
- Interviews about Particle Physics at the media.
- Schools visits at the Research Lab and the Atomic & Nuclear undergraduate labs.

2. The Division of Electronics

- Faculty (4 people): 1 Professor, 2 Assoc. Professors, 1 Lecturer
- Ph.D. Students: 5
- Technical Staff: 2

- Educational and Research Activities
  - Basic and Advanced Analog and Digital Electronics
  - Embedded System Design
  - Microelectronics Design
  - Measurement and Controls System

AUTH e-LAB

Aristotle University of Thessaloniki-Electronics Laboratory

The Division of Electronics

Research at the Division

- **Digital Circuits**
  - Design of high-performance low-power digital circuits and embedded systems
  - Development of cell models for timing analysis and power consumption
  - Development of power models for digital architectures, μP and μC
- **Analog circuits**
  - Low-power low-voltage analog circuits
  - RF circuit design
  - Analog circuits for signal processing and sensor interfacing
  - Energy harvesting circuits
- **Measurement & control systems**
  - Signal measurement and analysis using DSPs and μCs
  - Development of automated telemetric systems for measuring environmental parameters (networks of microcontrollers)

The Division of Electronics

Research of the IAPP-FTK group: *Digital Circuit and System Design*

- High speed and Low power circuit design
- Hardware design for image and video applications

  -Machine vision in LOC applications
  - - Edge detection (Canny)
  - - Frame detection (modified Hough)
  - - Flow detection algorithm
- Design of Self-checking circuits and processors
- Methodologies for the design of reconfigurable processors and ASIPs
- Methodologies for development efficient multi-core systems on FPGAs
- Methodology for the development of an hierarchical memory system for low power consumption

The Division of Electronics

Research of the IAPP-FTK group: *Models for Power Consumption*

- Instruction level energy models for microprocessors and microcontrollers

  - Energy estimation of SW implementations

- Development of an environment for monitoring and measuring the instantaneous current used for models development

- Power consumption models for DSP architectures based on signal statistics

The Division of Electronics

Research of the IAPP-FTK group:

CMOS Cell Modelling

Cell models for:

- Timing analysis
- Power estimation

Analytical expressions for:

- Output voltage waveform
- Driving current
- Short circuit current
- Propagation delay
- Power consumption

Parametric expressions regarding:

- Supply voltage
- Threshold voltage
- Transistor width and length
- Input rise time
- Capacitive load
- Resistive load

Incorporation of variability effects

The Division of Electronics

Projects

- **Previous:**
  - "**Architectures and Methodologies for Dynamic Reconfigurable Logic**" (AMDREL) IST- 2001-34379, EU funded
  - "**Methodology Development for Optimum Design for Special Purpose Processors**", PENED '03, Nationally Funded
- **Current:**
  - "**Microelectronic elements for Lab-On-Chip Devices for Molecular Analysis targeting Genetic and Environmental Applications**", Nationally Funded by ESPA (Corallia)
  - "**Jordan Europe Wide Enhanced research Links in ICT**", Coordination and Support action, No 266507

The Division of Electronics

- Electronics Group in the FTK Project
  - S. Nikolaidis: Associate Professor
  - C.-L. Sotiropoulou: Ph.D. Student
  - C. Gentsos: Ph.D. Student

AUTH e-LAB

Aristotle University of Thessaloniki-Electronics Laboratory

In two words

- Faculty and students
- From two divisions:
  - One with experience in electronics: FPGA implementation
  - One with experience on High Energy Physics: where the product will be used, to improve the physics capabilities of the ATLAS experiment

We look forward to a very fruitful collaboration:
to contribute what we know,
to learn what we don't,
and all together to promote our research.

Extras

Division of Nuclear and Particle Physics
Existing Collaborations of the ATLAS Group

RD51 Collaboration (for gaseous micropatern detectors), http://rd51-public.web.cern.ch/

Collaborations for the Muon Chambers construction, Univ Athens, NTUA, CERN, Nikhef, INFN Frascati, Univ. of Freiburg, MPI Munich, Univ. Rome I, Univ. Michigan, Beijing, CEA Saclay, Dubna, Boston Univ., Brandeis Univ., Harvard, MIT, INFN Pavia, U Seattle, Weizmann

MAMMA, Muon Micromegas R&D Activity for the superLHC:
Broohaven National Laboratory (BNL), CERN, Demokritos Athens, Harvard University, National Technical University of Athens (NTUA), University of Athens, University of Thessaloniki.

Collaborations for physics analysis (ARTEMIS, RTN) : CEA Saclay France, University College London, University of Durham, Universita di Pisa, MPI für Physik Munchen, The University of Sheffield, CNRS Centre de Physique des Particules de Marseille CPPM, University of Thessaloniki.

NSRF: Thalis : Hellenic Open University, University of the Aegean, University of Athens, Demokritos Athens.

Mechanical Engineering Dept, AUTH.

Division of Nuclear and Particle Physics
PhD Theses: Completed or in Progress

PhD Theses:

On going

1.Nomidis Ioannis, 'B-physics di-lepton processes with the first ATLAS Data'.
2.Iliadis Dimitris, 'Multimuon studies with the first ATLAS Data'.
3.Vassiliki Kouskoura, 'Search for SUSY with the first data of ATLAS'.
4.Gkaitatzis Stamatios, (Oct 2012) 'Studies of diboson production with ATLAS Data'.
5.Kyriazopoulos Dimitris, (Oct 2012) 'Studies of 4 lepton production with ATLAS Data'.

Completed

1. Petridis Andreas, 'Studies of 4 lepton processes with the first ATLAS Data' (2008-12)
2. Konstantinos Bachas, 'Studies for the ATLAS Muon Spectrometer with Test Beam and Simulated Physics Data'. (2004-2008)
(Marc Virchaux Prize 2009 for outstanding PhD theses related to the ATLAS Muon Spect)
3. Krepouri Athanasia, 'Study of the performance of the ATLAS Muon tracking chambers in muon momentum reconstruction and its importance in the studies of Standard Model Physics'. (2000-2006)

The Division of Electronics

Infrastructure

- Avnet Spartan-6 LX150T Developers Kit with camera extension and daughter card, 2 Xilinx Virtex 5 XUPV-LX110T evaluation platforms, 12 Xilinx Spartan-3E Starter Boards and 5 XC9572 CPLDs, Altera Nios II Development Kit (Stratix II Edition). Full access to the Xilinx tools through Europractice.
- Cadence Suite through Europractice
- Measurement and analysis instruments for low frequency analogue electronic circuits (signal generators, analog and digital oscilloscopes of various types, voltmeters, power supply circuits etc). Specialized equipment (low-frequency spectrum analyzer, distortion measurement instrument, phase difference measurements, frequency meters, characteristic curve plotters for transistor and integrated circuit characterization).