An overview of the Experimental High Energy Activities in Greece

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TWEPP-08
Topical Workshop on Electronics for Particle Physics

An overview of the Experimental High Energy Activities in Greece

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The Activities

Greek Experimental HEP Activities

Accelerator Experiments	Non-Accelerator Experiments	Detector/Acceleratotor R&D
PhD's 44	PhD's 12	PhD's 3
PhD-students 30	PhD-students 4	PhD-students 2

Accelerator Physics Experiments

CERN

LHC Experiments — nTOF

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

Accelerator Physics Activities

Fermilab Experiments		DESY Experiments
Tevatron-CDF	Neutrino Physics	HERA-H1/ZEUS
PhD's 1	PhD's 1	PhD's 3
PhD-students 2	PhD-students 1	PhD-students 1

Non-Accelerator Physics Experiments

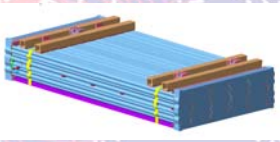
Experiments in Greece		Experiments at CERN
NESTOR	HELYCON	CAST
PhD's 4	PhD's 3	PhD's 4
	PhD-students 2	PhD-students 2

The Greek ATLAS Project

NKUoA, NTUA, AUTh all three institutes collaborated for the construction of the **BIS chambers of the ATLAS Muon sSpectrometer**, 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



C. Kourkoumelis This Conference

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/Ψ K+)

C. Kourkoumelis This Conference

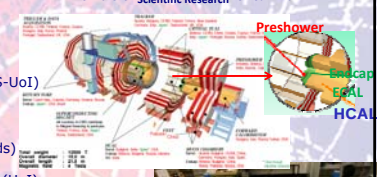
CMS in Greece

University of Athens | Demokritos National Center for Scientific Research | University of Ioannina

2008: 17 PhD physicists

Participation:

- **CMS Preshower** (DEMOKRITOS-UoI)
  - Development
    - sensors (Si-strip-hybrids)
    - FE:development & test (UoI)
    - Off -detector electronics (UoI)
    - Preshower DAQ (UoI)
    - Assembly & test
      - 1000 μmodules (DEMOKRITOS)
  - Simulation-calibration
  - DQM (UoI)
  - Beam tests



Preshower μmodule (total 4288)

Preshower: One D (1/8)

Preshower will be inserted in CMS during the LHC winter shutdown.

N. Manthos This Conference

CMS in Greece

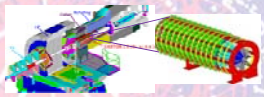
Participation(continue):

- **Trigger/DAQ** (mainly DEMOKRITOS)
  - Development (GTPe)
  - Construction (IOP, GTPe)
  - Evaluation

Input-Output Processor (IOP)

Global Trigger Processor emulator (GTPe)

- **CASTOR** (UoA)
  - Project management
  - Development-Simulations
  - Construction
  - Evaluation
  - Beam tests



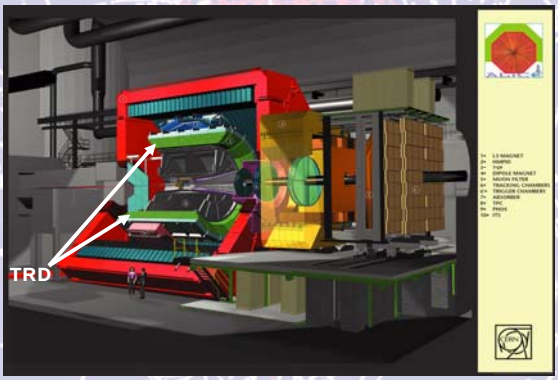
CASTOR: quartz / tungsten Cherenkov EM/HAD calorimeter, at the very forward rapidity region for forward QCD studies and unexplored cosmic ray phenomena.
Half of the CASTOR is installed in the CMS line for the LHC start up.

- **Physics analysis**
  - CMS physics coordination (UoA)
  - Physics analysis of ECAL-Preshower test-beam data (DEMOKRITOS, UoI)
  - Physics analysis for the CMS Physics-TDR (DEMOKRITOS, UoA)
  - Development of n^0 rejection algorithms & electron efficiency (DEMOKRITOS)
  - Di-leptons + Jets + MET channel (UoA)
  - MSSM and little Higgs search (DEM.)
  - W and Z x-section,in the electron channel Zγ (ISR) and TGC (DEMOKRITOS)

- **Future plans**: Data Analysis, SLHC.

N. Manthos This Conference

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.
  - Comprises Software upgrade for online monitoring (MOOD)
- Software development for Data Flow Control for all ALICE detectors (AMORE)

Hardware Contributions of the NKUoA to ALICE

HVDS Description

➔ 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.

XXVI Workshop on Recent Developments in HEP — M. Vassiliou

Hardware Contributions of the NKUoA to ALICE

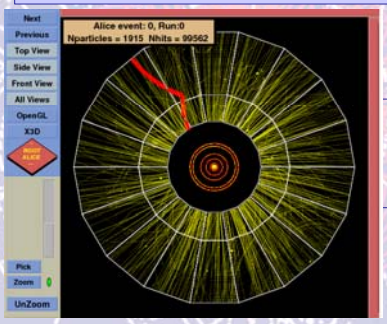
HVDS Specifications

Both Systems:		
	Output Channels	180
	ramp-up rate	1-30 V/s
	ramp-down rate	1-100 V/s
	HV stability	<0.1% /24h
	Achieved HV stability	**~0.002% /24h**
	Ripple rejection	~40 dB
	Current accuracy	<0.2%
	Achieved Current accuracy	**~0.03%**
	response time	< 50 ms
Anode System:		
	Dynamical range	900 – 1900 V
	Max. current	7 uA
Drift System:		
	Dynamical range	1450 – 2500 V
	Max. current	270 uA

Contributions to Physics Analysis Software of the NKUoA in ALICE

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

n_TOF – Phase 2 2008 and beyond

Capture measurements	
Mo, Ru, Pd stable isotopes	r-process residuals calculation isotopic patterns in SiC grains
Fe, Ni, Zn, and Se (stable isotopes) ^{79}Se	s-process nucleosynthesis in massive stars accurate nuclear data needs for structural materials
A~150 (isotopes varii)	s-process branching points long-lived fission products
^{234,236}U, ^{231,233}Pa	Th/U nuclear fuel cycle
^{235,238}U	standards, conventional U/Pu fuel cycle
^{239,240,242}Pu, ^{241,243}Am, ^{245}Cm	incineration of minor actinides

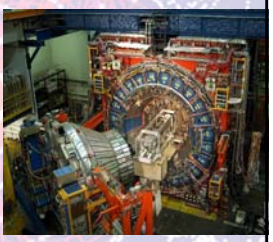
Greek Contribution to nTOF

- Aristotle University of Thessaloniki
- NTUA
- University of Ioannina
- NRCPS Demokritos

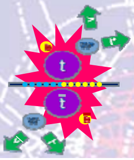
- Measurements relevant to fundamental physics,
  - Nuclear Astrophysics,
- Nuclear fuel cycles and incineration of nuclear waste

Accelerator Experiments:FermiLab Tevatron-CDF

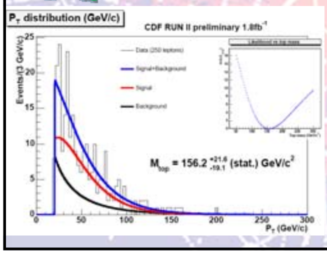
- Participation: University of Athens
  - Activity:
    - Top mass measurement
      Use P_T of lepton to estimate mass
    - W->ev cross-section measurement
      Use forward electrons

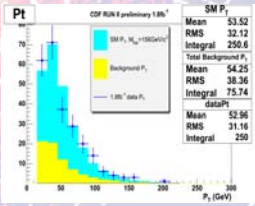


Greece in CDF



- 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

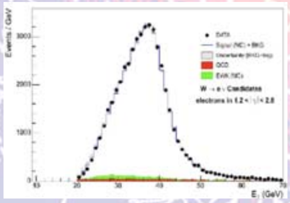




V.Giakoumakopoulou PhD Thesis

Greece in CDF

- Forward electron P_T spectrum
  - Measured cross-section
    $\sigma(p\bar{p})\cdot Br(W\to e\nu)=(2796\pm13(stat)$[illegible]$(syst)\pm$[illegible]$(lum))pb$
  - Compared to cross-section from central region
    $\sigma(p\bar{p})\cdot Br(W\to e\nu)=(2780\pm14(stat)\pm60(syst)\pm167(lum))pb$
  - Theoretical prediction : 2720±130pb



A. Staveris 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.
- MINERvA Experiment (In construction phase); PMT Testing and Characterization; Design of the Test stand; Software development
- NOvA Experiment (In construction)
- Construction of a PET prototype

N. Saoulidou:	DONuT (PhD),	MINOS
C. Andreopoulos:	DONuT,	MINOS (PhD)

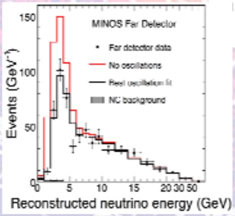
The MINOS Experiment

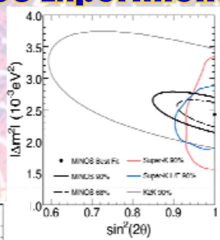
Beam: NuMI beam, 120 GeV Protons → ν_μ- beam(High Intensity)

Detectors: ND, FD

Near Det: 980 ton version of FD, at FNAL (L ≈ 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:
$|\Delta m^2| = 2.43\times10^{-3}$ eV^2
$\sin^2(2\theta)$ =1.00

World's Best Δm^2 measurement

The MINOS Experiment

FAR MINOS DETECTOR

5.4 kton Magnetized Scintillator Calorimeter/Muon Spectrometer

Structure: Steel / Scintillator

- 2.5 cm thick steel
- 4 cm x 1 cm polystyrene strips in Al cover
- WLS fiber
- 8m x 8m Octagonal Planes
- 8 modules/plane, 192 strips/plane
- 15.2 k A-turn coil
- Cosmic Ray Shield

Total: 486 Layers → 5.4 kTon

- Electronics: Viking chip (VA) based

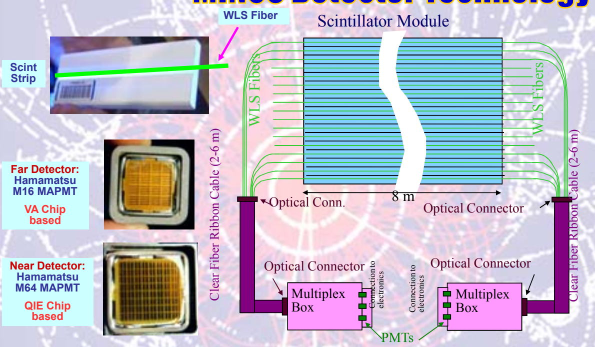
NEAR MINOS DETECTOR

Emulates the Far detector
in absorber, active planes, and Bfield.

Structure:
Veto section
Target section
Shower detector
Muon spectrometer
282 steel planes
153 scint. Planes
1 kT, 3.8 m x 4.8 m
"squeezed" octagon

Electronics: QIE chip based

MINOS Detector Technology



Objects not to scale

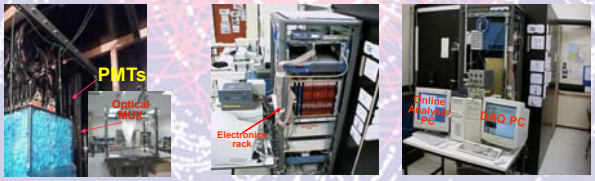
NKUoA in MINOS

- *WHAT TO TEST*
- Gain determination (dependence on HV)
- Compute Nominal HV (Gain = $1x10^6$)
- Dark count spectra and dark count rate
- Verify good SPE separation
- Cross-talk
- Uniformity
- Linearity
- Long term stability

Constructed an Automated Test Station for Hamamatsu M16

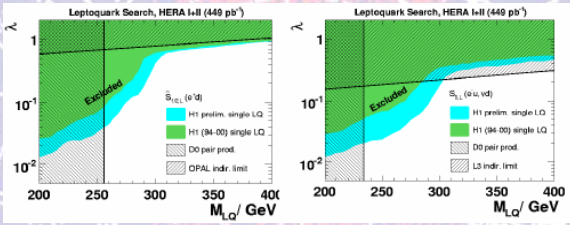
- Performs a wide range of precise measurements
- Tests 10 PMTs simultaneously
- Fully automatic
- runs a sequence of data-taking modes
- without 'human' intervention for ~ 3 days
- at 500 Hz DAQ rate Þ ~ 2 GBs/batch (not raw data)

Total number of tested PMTs for MINOS FAR DETECTOR: 750



Greece in HERA/H1

NTUA-Exotics

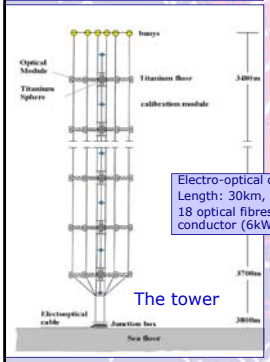


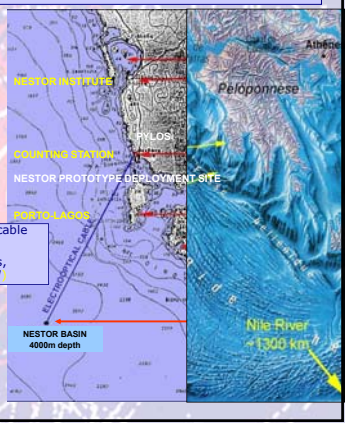
LQ Exclusion Limits – Comparison with LEP & Tevatron
HERA extends the exclusion region

I. Panagoulias DIS2008 – work on PhD / NTUA & H1/HERA

The Nestor Project in Greece

NESTOR neutrino telescope sketch. Several floors are shown

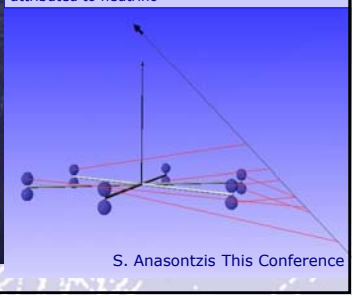




The Nestor Project in Greece

Pictorial representation of a muon track (blue line).

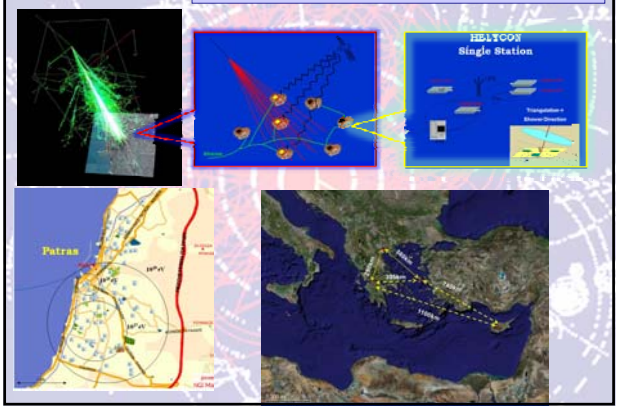
- Pink lines represent Cherenkov photons hitting the photomultipliers.
- Tracks coming from below could be attributed to neutrino



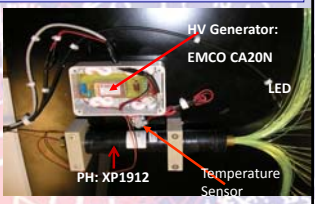
S. Anasontzis This Conference

HELYCON

Hellenic Lyceum Cosmic Observatories Network



HELYCON: Detector Construction

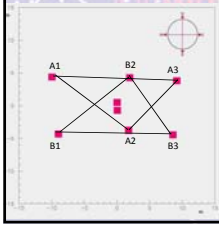


- Obtain direction of showers from time differences between stations
- Correlations between showers
- Flux of showers
- ✓ Synchronization between stations achieved through GPS

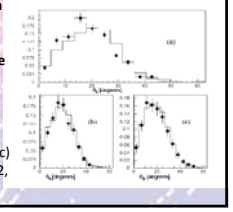
HELYCON: Testing and Shower Reconstruction

Single Station equipped :

- 4 scintl.counters
- GPS synchr. system
- PC based DAQ syst



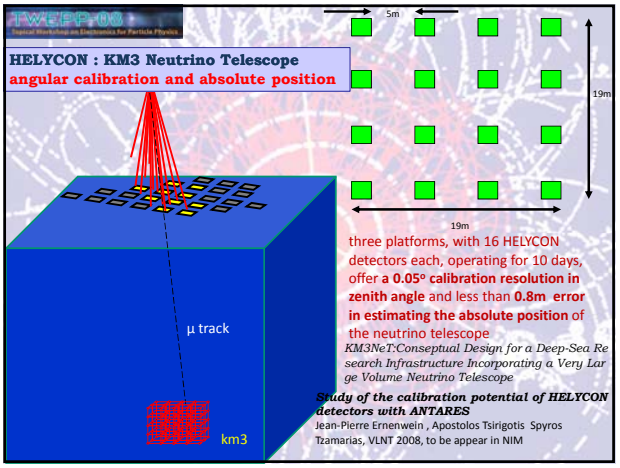
Zenith angle distribution of reconstructed atmospheric showers (data points) with Monte Carlo (CORSICA, solid line) predictions using: a) the detectors A1, A2, A3, B1, B2, B3, b) the counters A1, A2, A3 and c) using the counters B1, B2, B3



HELYCON: Detector Deployment

Patras		Chios		Nicosia		Thessalonica	
2007-2008	2008-2009	2007-2008	2008-2009	2007-2008	2008-2009	2007-2008	2008-2009
4 stations	4+6 stations		4 stations		1 station		1 station

HELYCON : KM3 Neutrino Telescope angular calibration and absolute position



three platforms, with 16 HELYCON detectors each, operating for 10 days, offer a **0.05° calibration resolution in zenith angle** and less than **0.8m error in estimating the absolute position** of the neutrino telescope

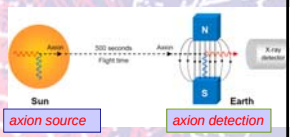
KM3NeT:Conseptual Design for a Deep-Sea Research Infrastructure Incorporating a Very Large Volume Neutrino Telescope

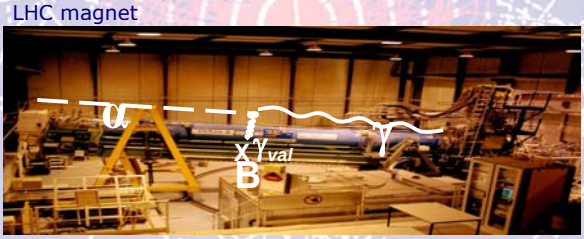
Study of the calibration potential of HELYCON detectors with ANTARES

Jean-Pierre Ernenwein , Apostolos Tsirigotis Spyros Tzamarias, VLNT 2008, to be appear in NIM

CAST in Greece

- 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

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

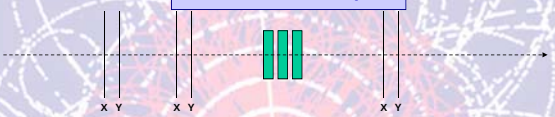
Demokritos

Univ. of Athens

Univ. of Thessaloniki

Technical Univ. of Athens

The Telescope



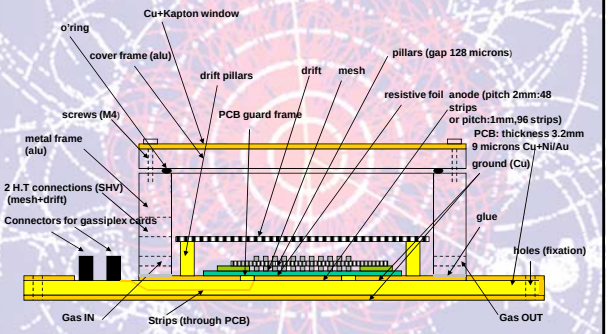
Detector parameters

- 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 GASSIPLEX 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

The Test beam prototype



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