TWEPP-08

Topical Workshop on Electronics for Particle Physics

# An overview of the Experimental High Energy Activities in Greece

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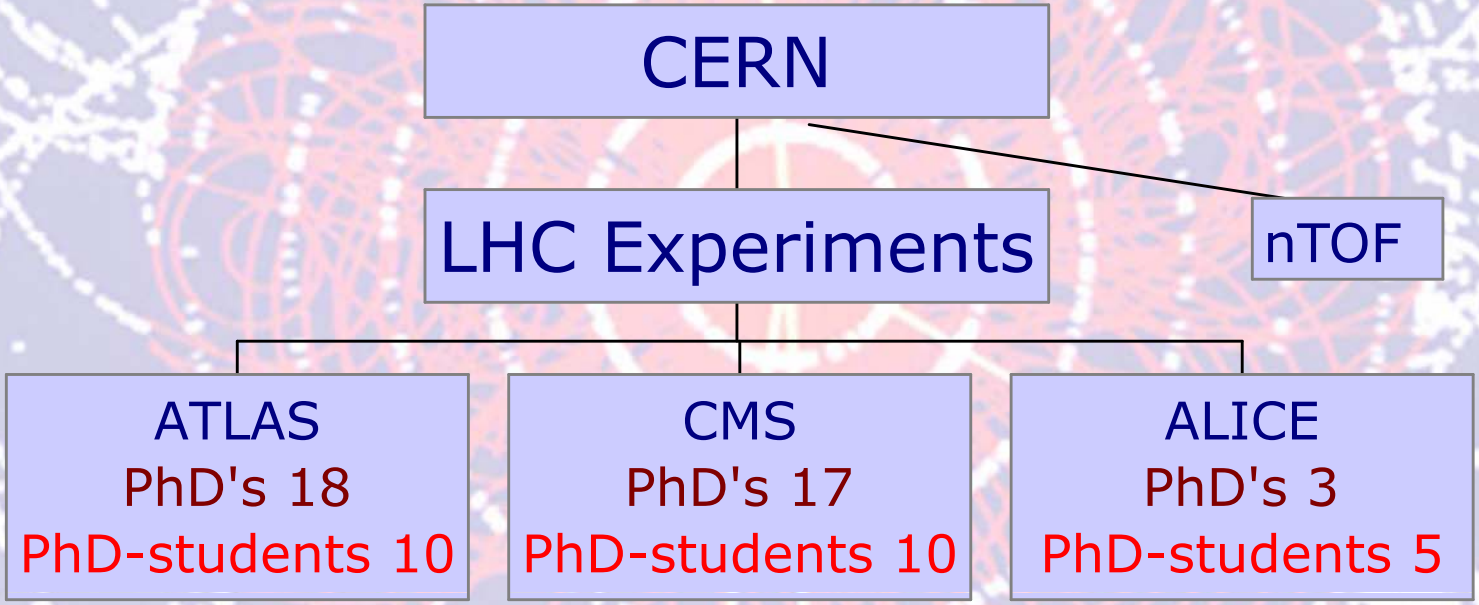
# The Activities

## Greek Experimental HEP Activities

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

# Accelerator Physics Experiments



# Accelerator Physics Activities

## Fermilab Experiments

- Tevatron-CDF
  - PhD's 1
  - PhD-students 2
- Neutrino Physics
  - PhD's 1
  - PhD-students 1

## DESY Experiments

- HERA-H1/ZEUS
  - PhD's 3
  - PhD-students 1

# Non-Accelerator Physics Experiments

## Experiments in Greece

- NESTOR
  - PhD's 4
- HELYCON
  - PhD's 3
  - PhD-students 2

## Experiments at CERN

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

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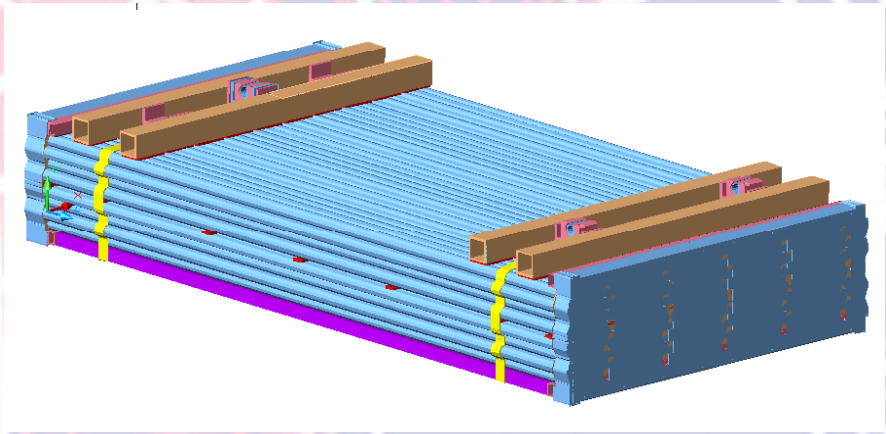
# The Greek ATLAS Project

**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+ )

# CMS in Greece

University of Athens

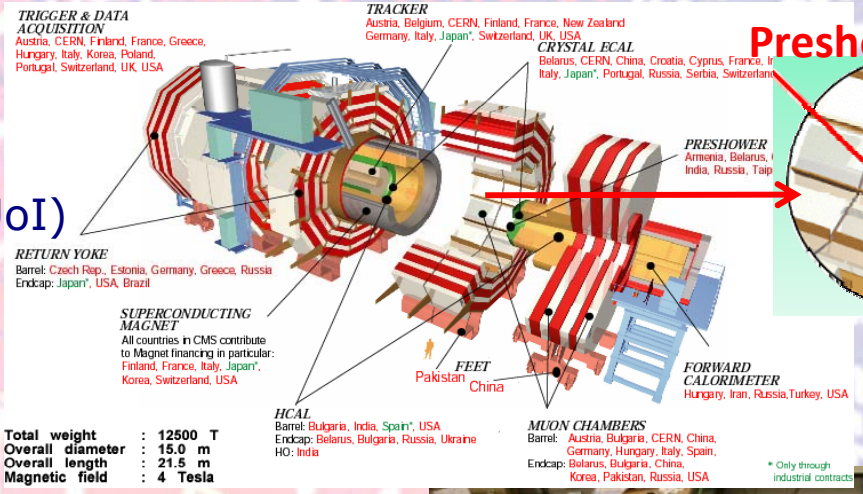
Demokritos National Center for Scientific Research

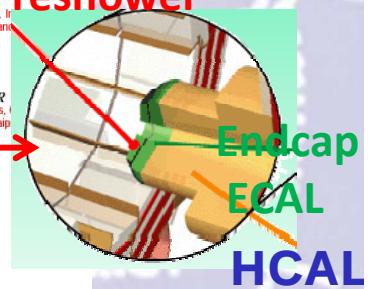
University of Ioannina

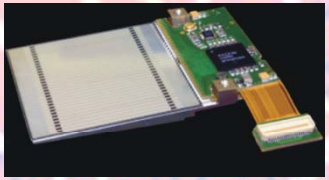
**2008: 17 PhD physicists**

Participation:

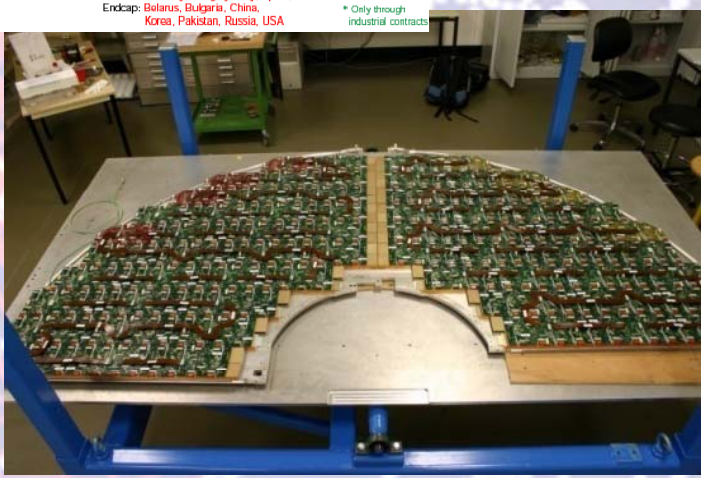
- **CMS Preshower** (DEMOKRITOS-UoI)
  - Development
    - sensors (Si-strip-hybrids)
    - FE:development & test (UoI)
    - Off -detector electronics (UoI)
    - Preshower DAQ (UoI)
    - Assembly & test
      - 1000 μmodules (DEMOKRITOS)
  - Simulation-calibration
  - DQM (UoI)
  - Beam tests



**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

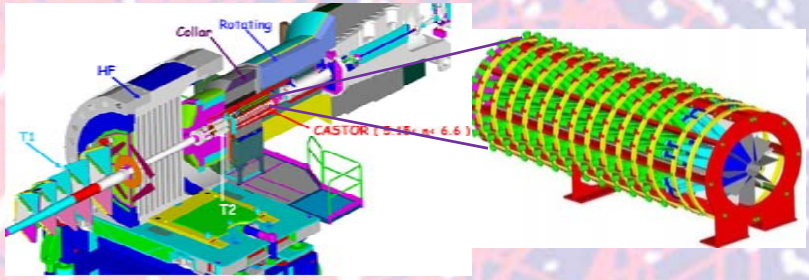
Participation(continue):

- **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 $\pi^0$ 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.

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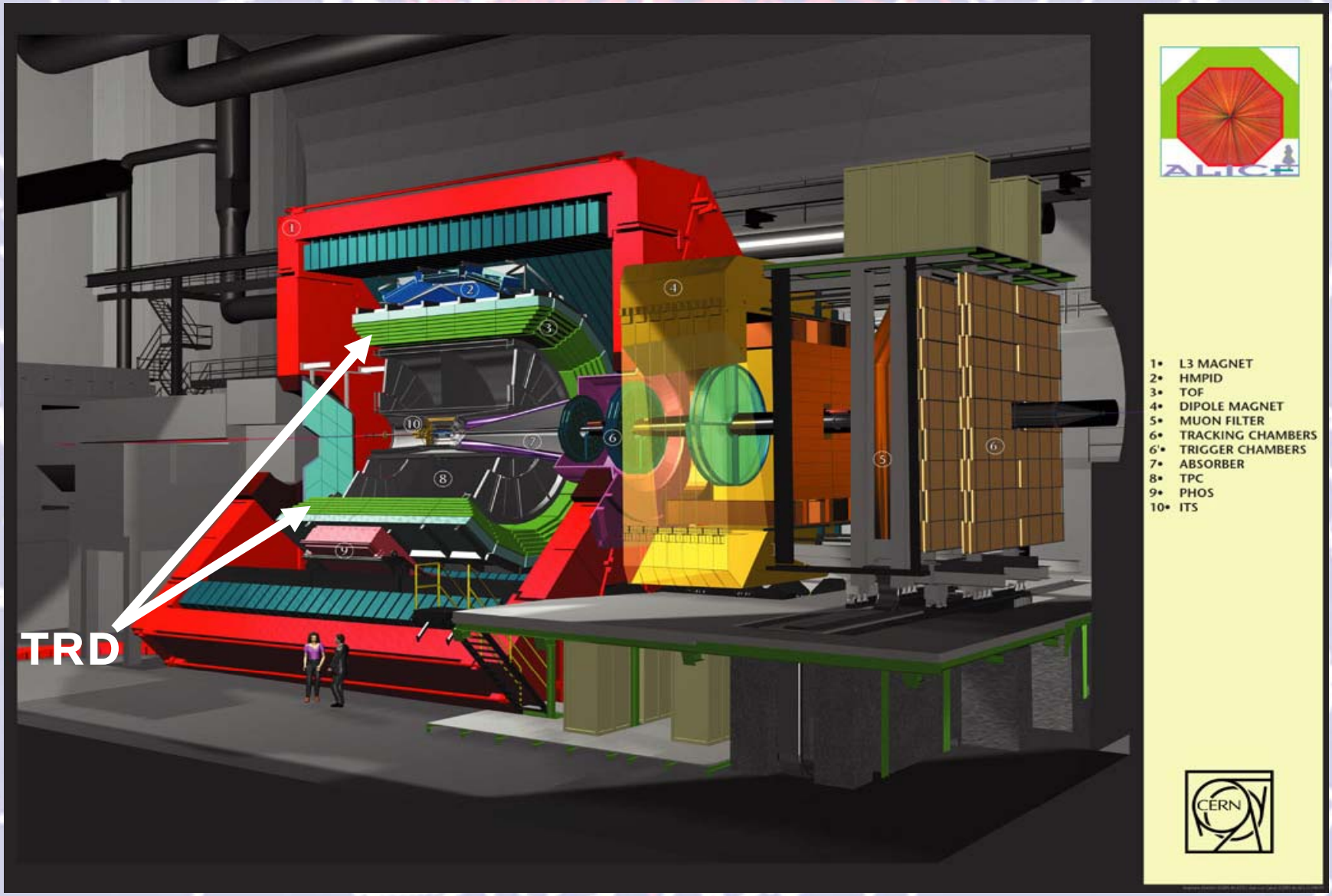
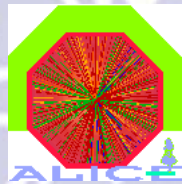
# ALICE in Greece






# Hardware/Software Contributions of the NKUoA to ALICE

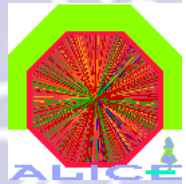
- Design, development and construction of the H.V. Distribution System (HVDS) for the TRD detector.
- Design and development of a monitoring system (Gate Pulser) for the ALICE TPC.
- Development of the DAQ monitoring system for the Forward detectors of ALICE -used by all ALICE detectors.
  - Comprises 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.




# 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 |

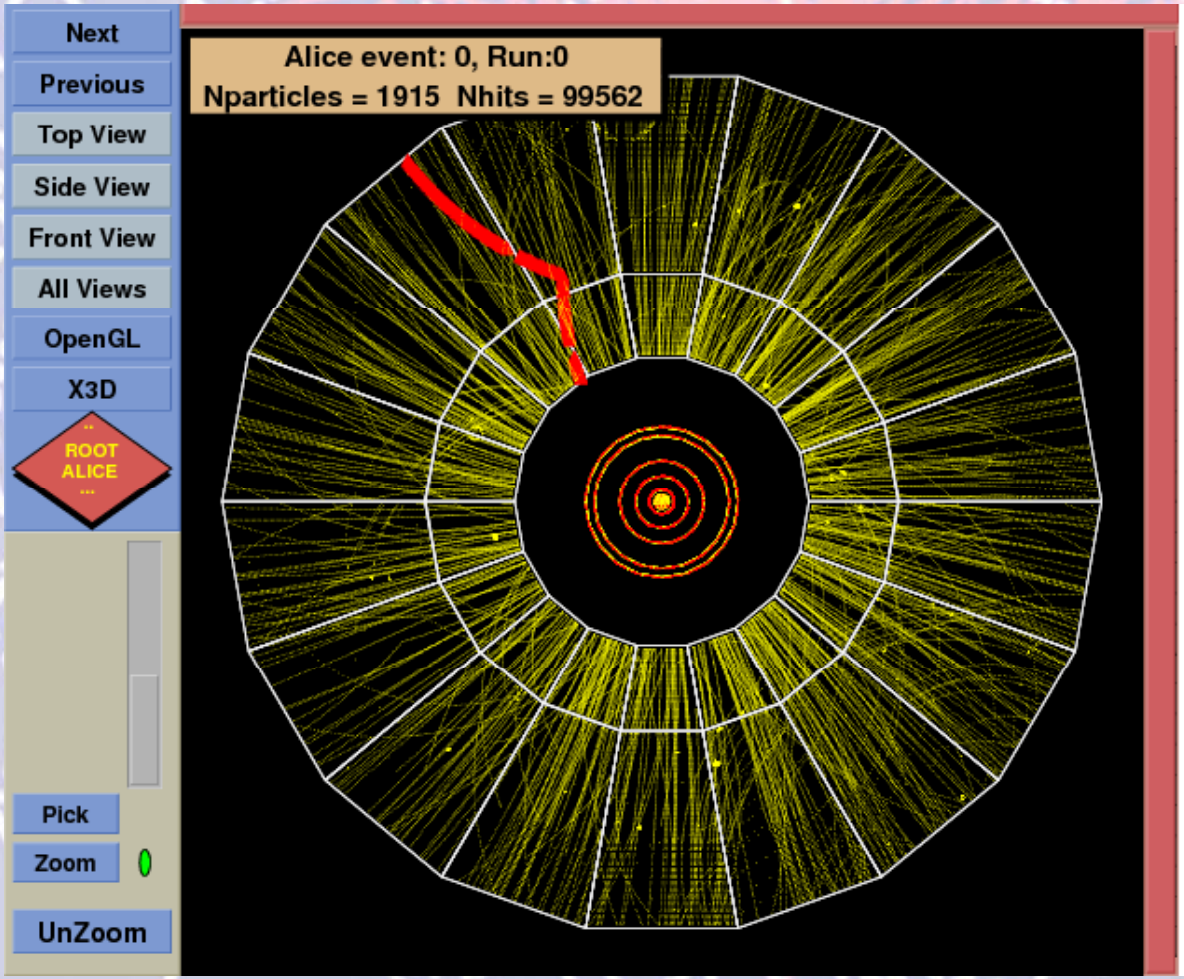
Drift System:

| | |
|---|---|
| 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<br>isotopic patterns in SiC grains |
| Fe, Ni, Zn, and Se (stable isotopes)<br>$^{79}$Se | s-process nucleosynthesis in massive stars<br>accurate nuclear data needs for structural materials |
| A≈150 (isotopes varii) | s-process branching points<br>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

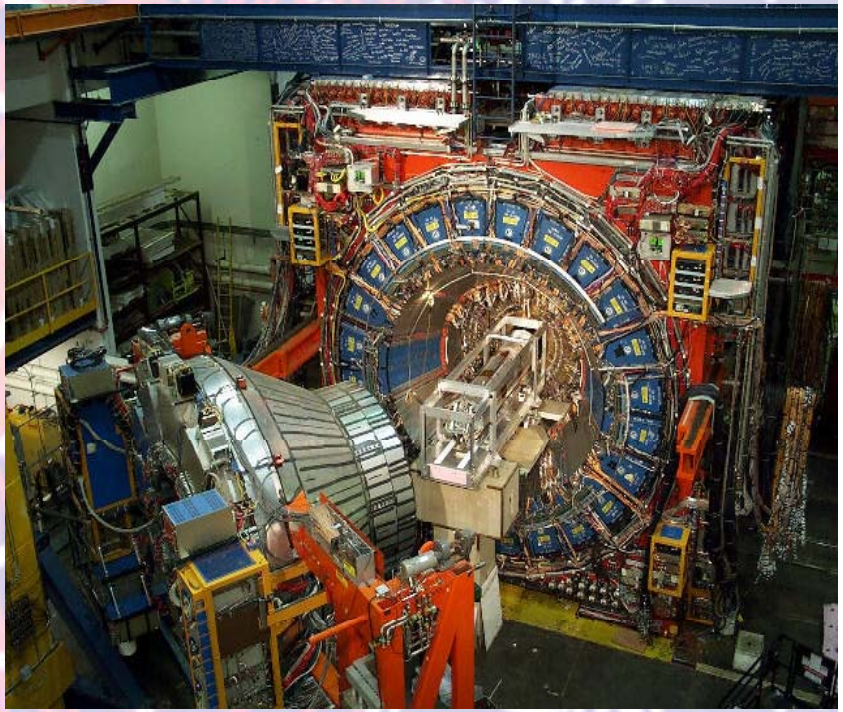
- Measurements relevant to fundamental physics,
  - Nuclear Astrophysics,
- Nuclear fuel cycles and incineration of nuclear waste

# Accelerator Experiments:FermiLab Tevatron-CDF

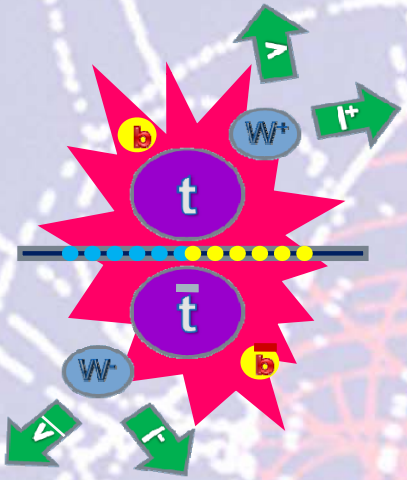
- Participation: University of Athens
  - Activity:
    - Top mass measurement

      Use $P_T$ of lepton to estimate mass
    - W->ev cross-section measurement

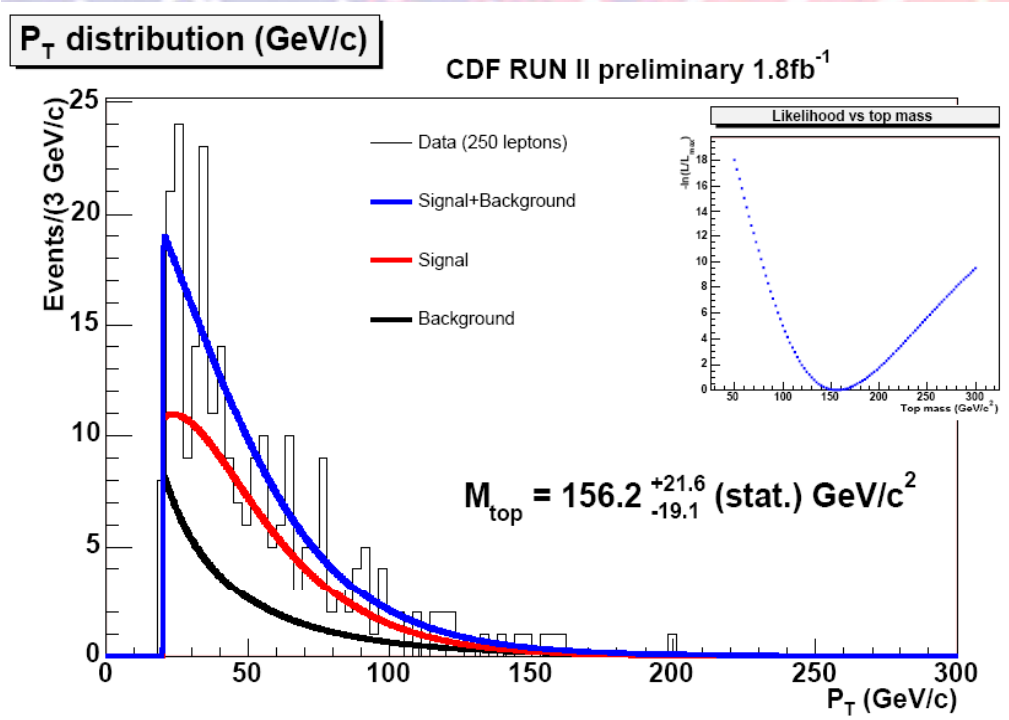
      Use forward electrons

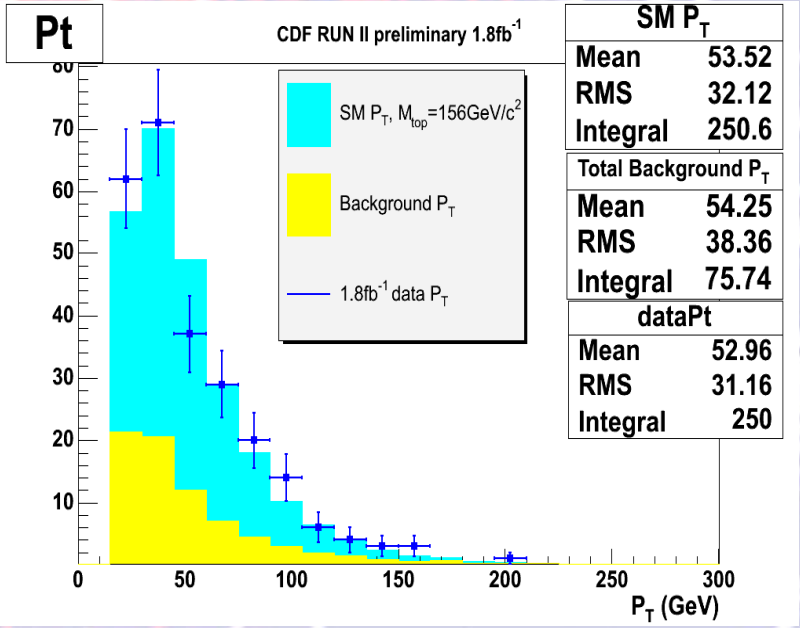


# Greece in CDF




- 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

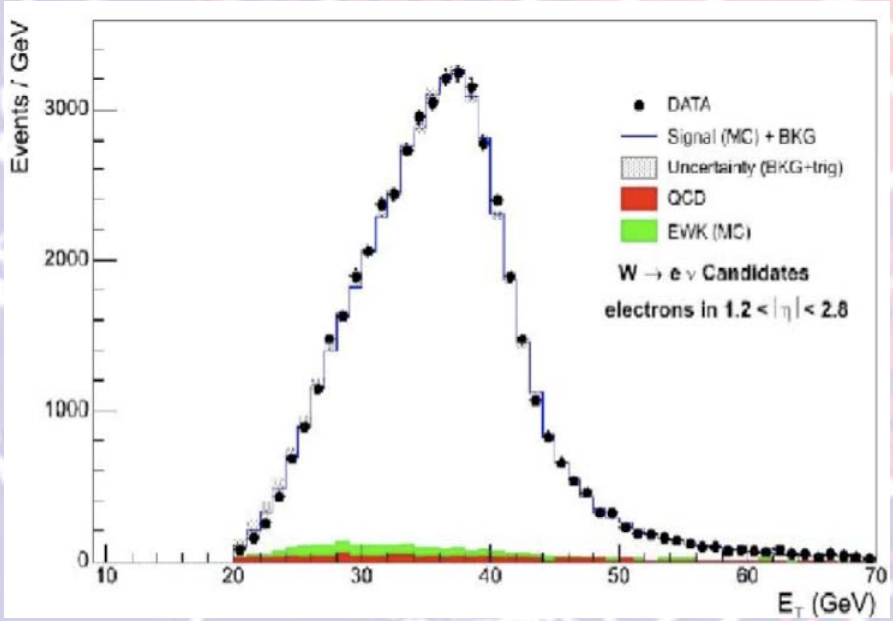
$$\sigma(p\bar{p})\cdot Br(W\rightarrow e\nu)=(2796\pm 13(stat)^{-95}_{-90}(syst)\pm 168(lum))pb$$

Physical Review Letters volume 98 issue 25, page 251801.

  - Compared to cross-section from central region

$$\sigma(p\bar{p})\cdot Br(W\rightarrow e\nu)=(2780\pm 14(stat)\pm 60(syst)\pm 167(lum))pb$$

  - 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) |

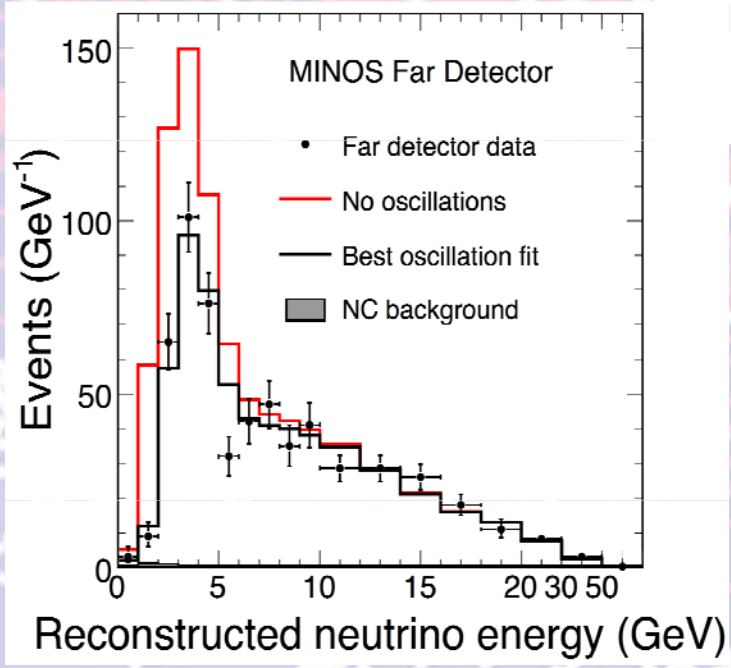
# The MINOS Experiment

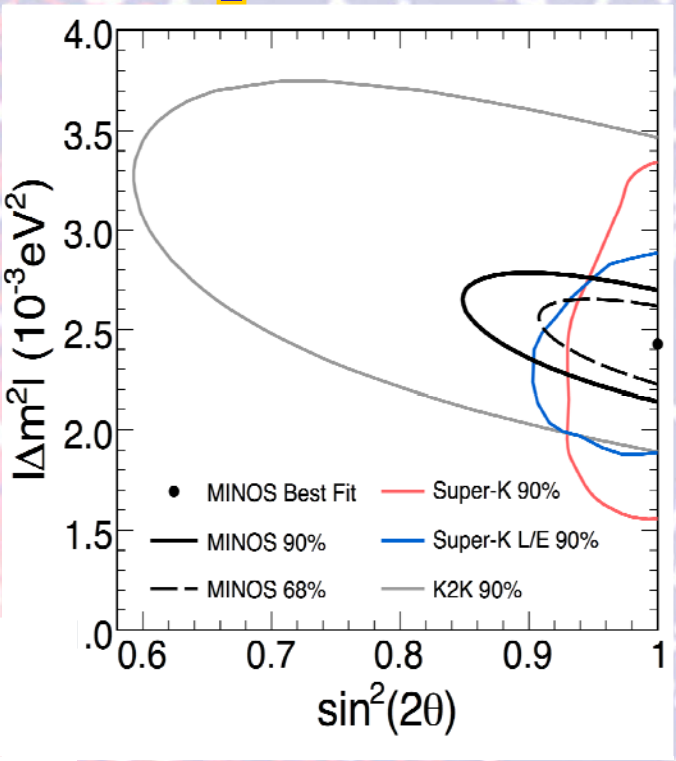
**Beam:** NuMI beam, 120 GeV Protons → $\nu_\mu$- beam( High Intensity)

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

**World's Best $\Delta m^2$ 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.**

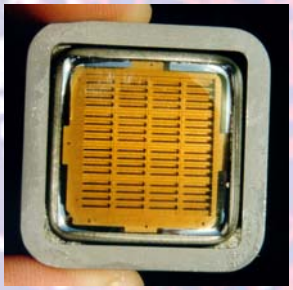
**Structure:**
Veto section
Target section
Shower detector
Muon spectrometer
282 steel planes
153 scint. Planes
1 kT, 3.8 m x 4.8 m
"squeezed" octagon

**Electronics: QIE chip based**

# MINOS Detector Technology

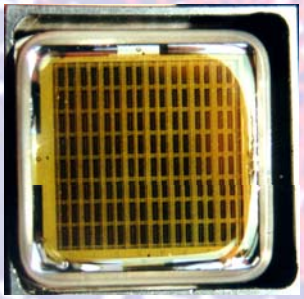

**Far Detector:**
**Hamamatsu**
**M16 MAPMT**

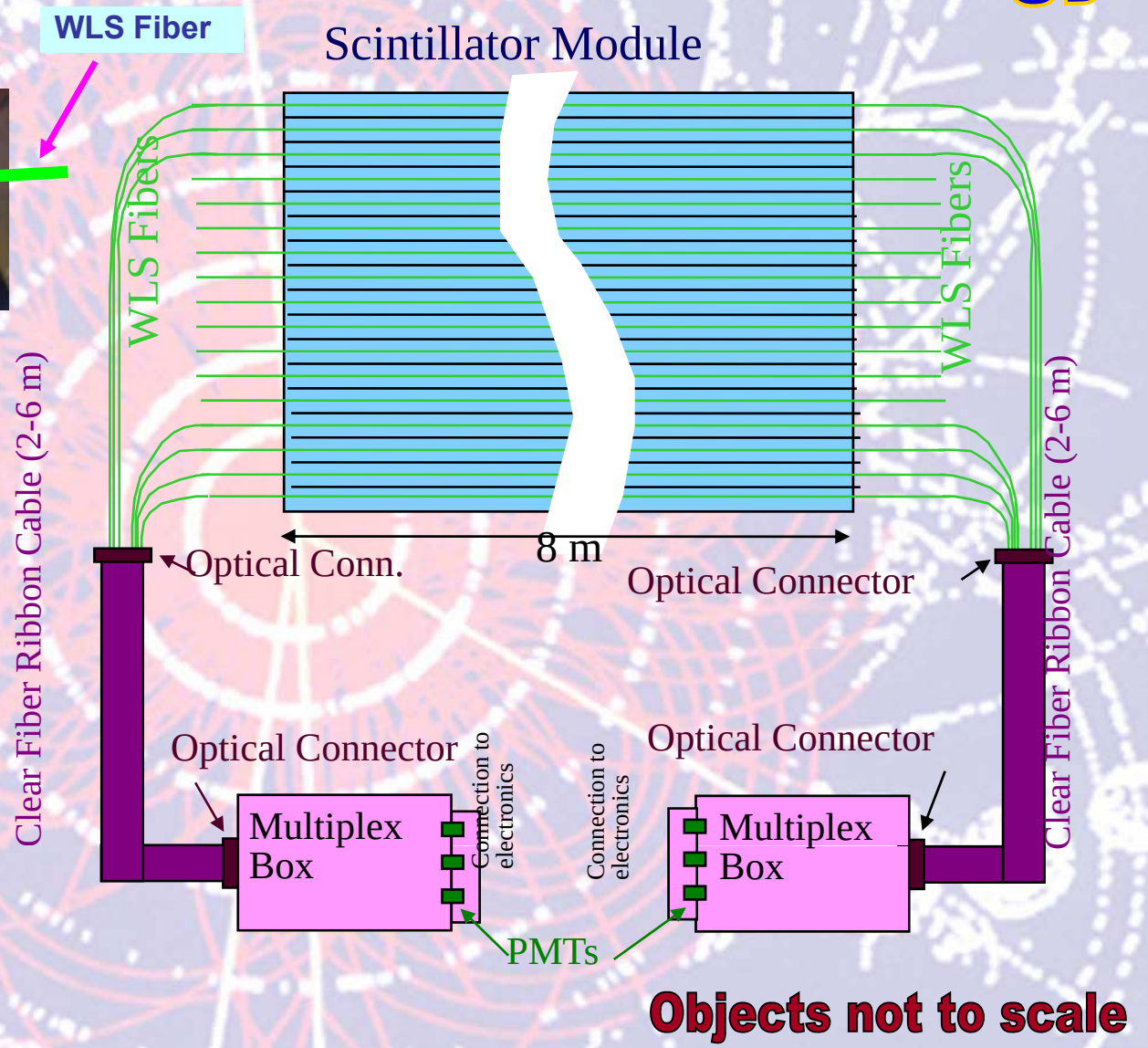
**VA Chip based**



**Near Detector:**
**Hamamatsu**
**M64 MAPMT**

**QIE Chip based**





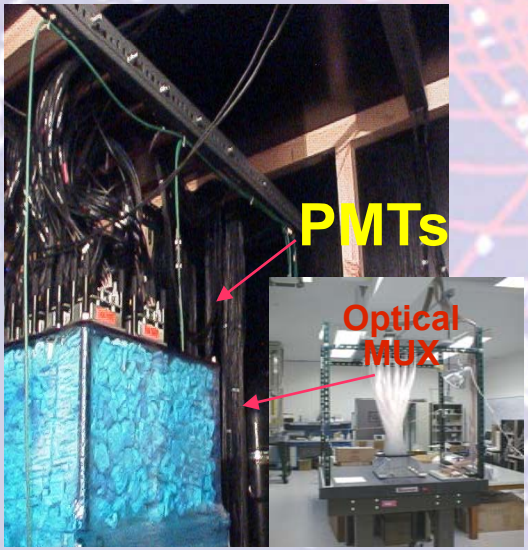
# NKUoA in MINOS

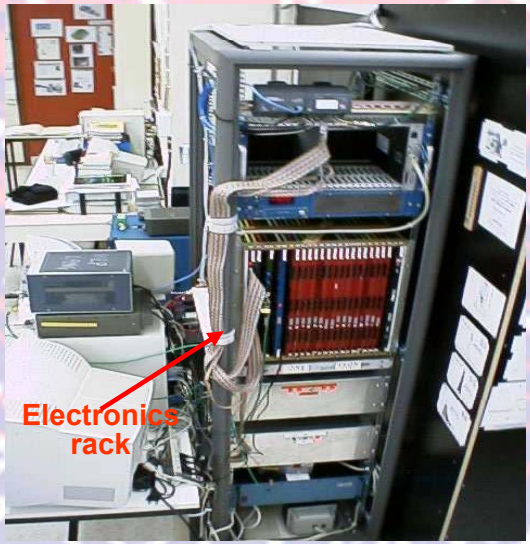
- *WHAT TO TEST*
- Gain determination (dependence on HV)
- Compute Nominal HV ( Gain = $1x10^6$)
- Dark count spectra and dark count rate
- Verify good SPE separation
- Cross-talk
- Uniformity
- Linearity
- Long term stability

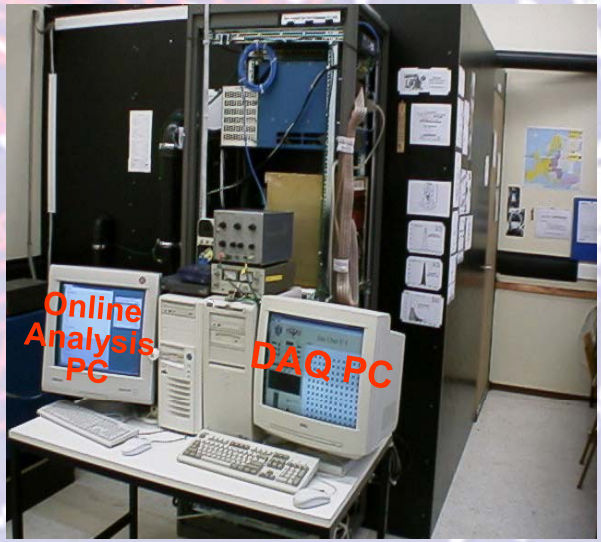
## Constructed an Automated Test Station for Hamamatsu M16

- 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

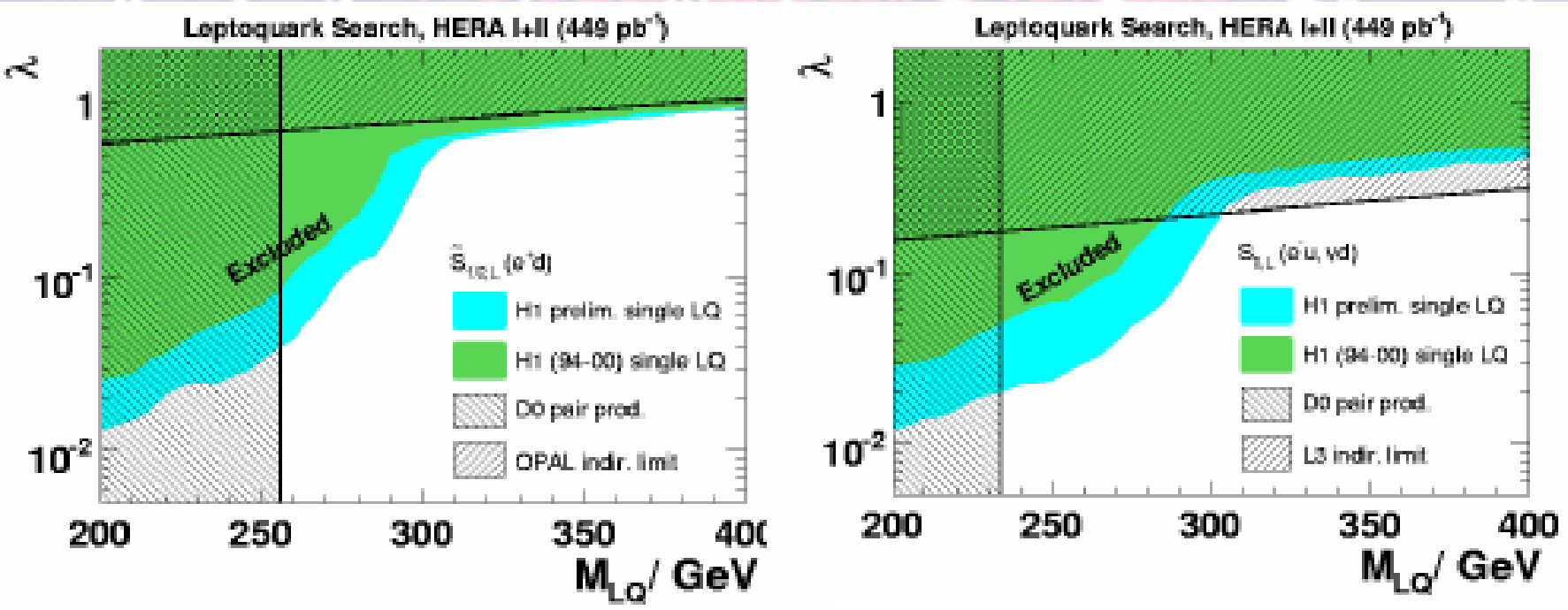


# Greece in HERA/H1

## NTUA-Exotics



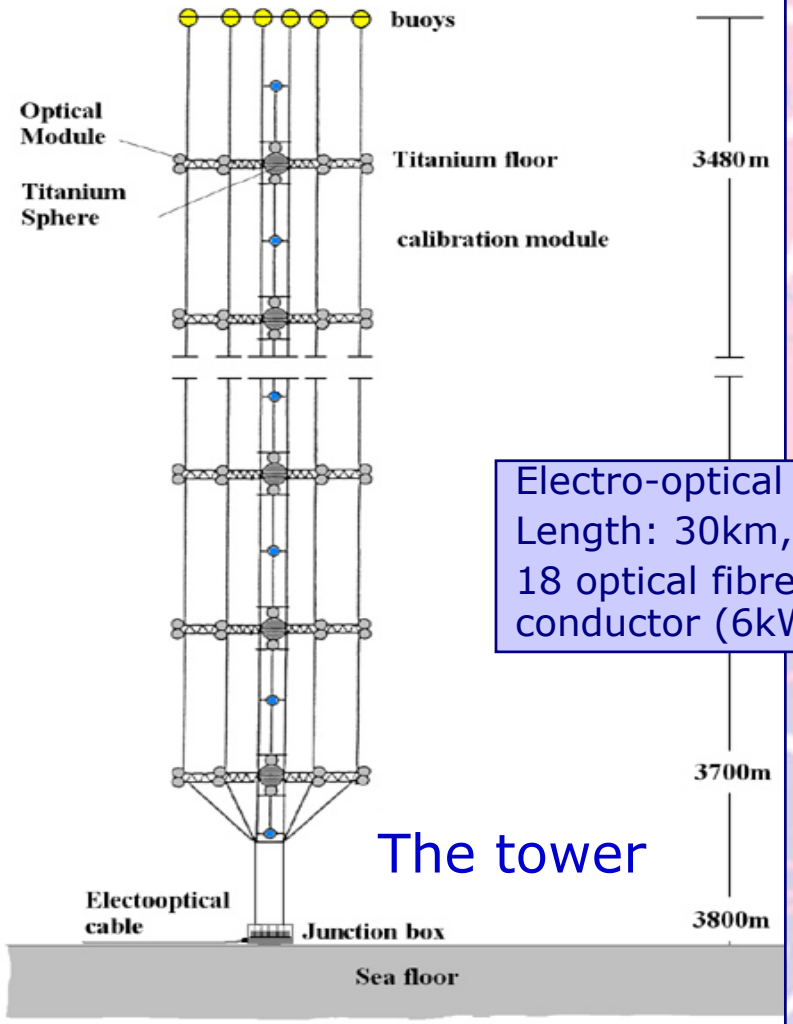

LQ Exclusion Limits – Comparison with LEP & Tevatron

HERA extends the exclusion region

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

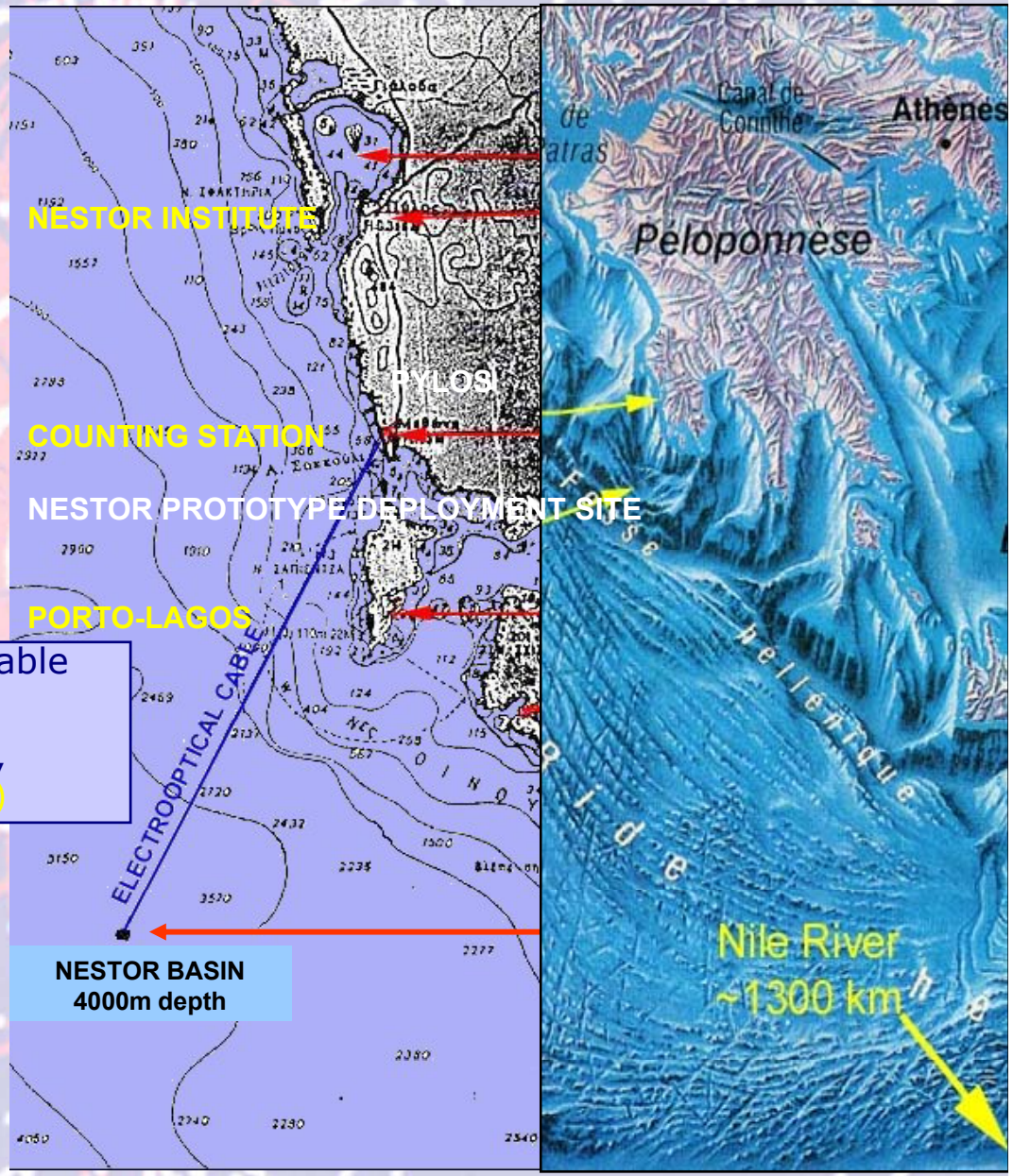
# The Nestor Project in Greece

NESTOR neutrino telescope sketch.
Several floors are shown

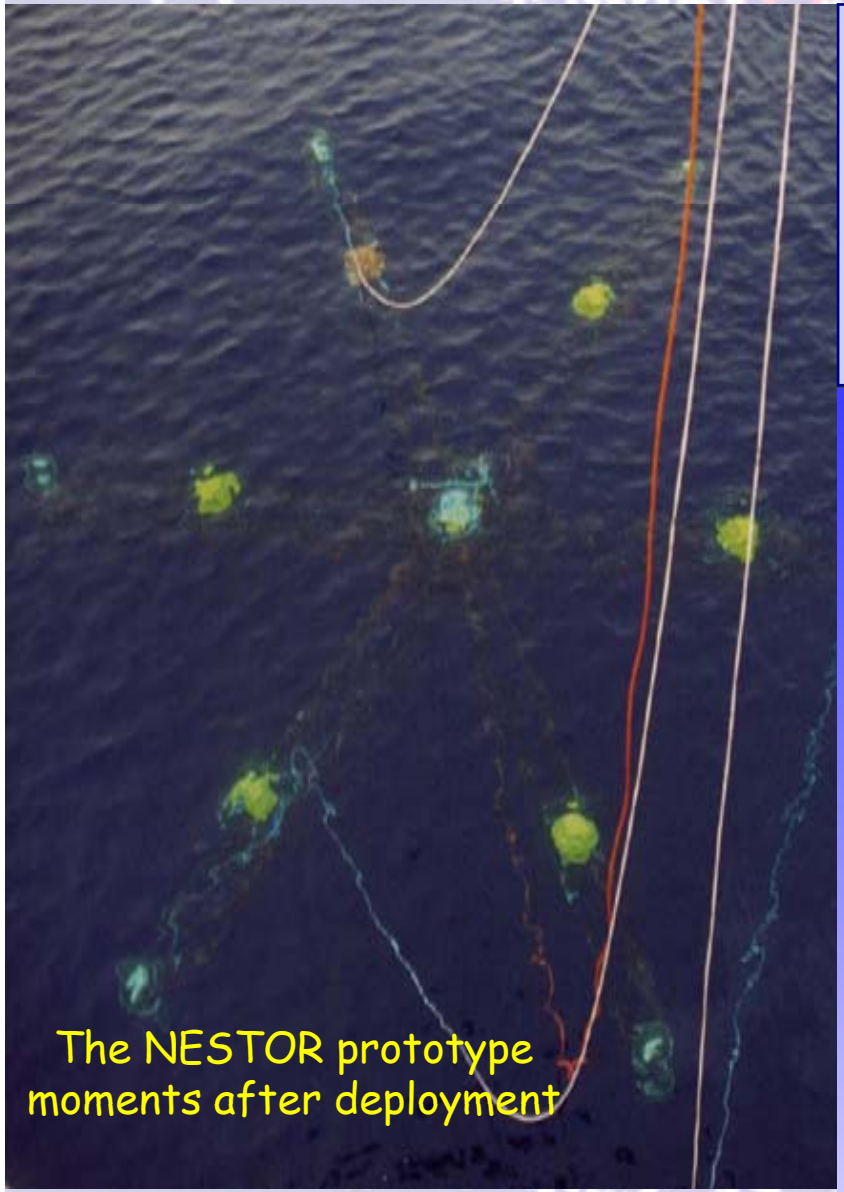



The tower

Electro-optical cable
Length: 30km,
18 optical fibres,
conductor (6kW)

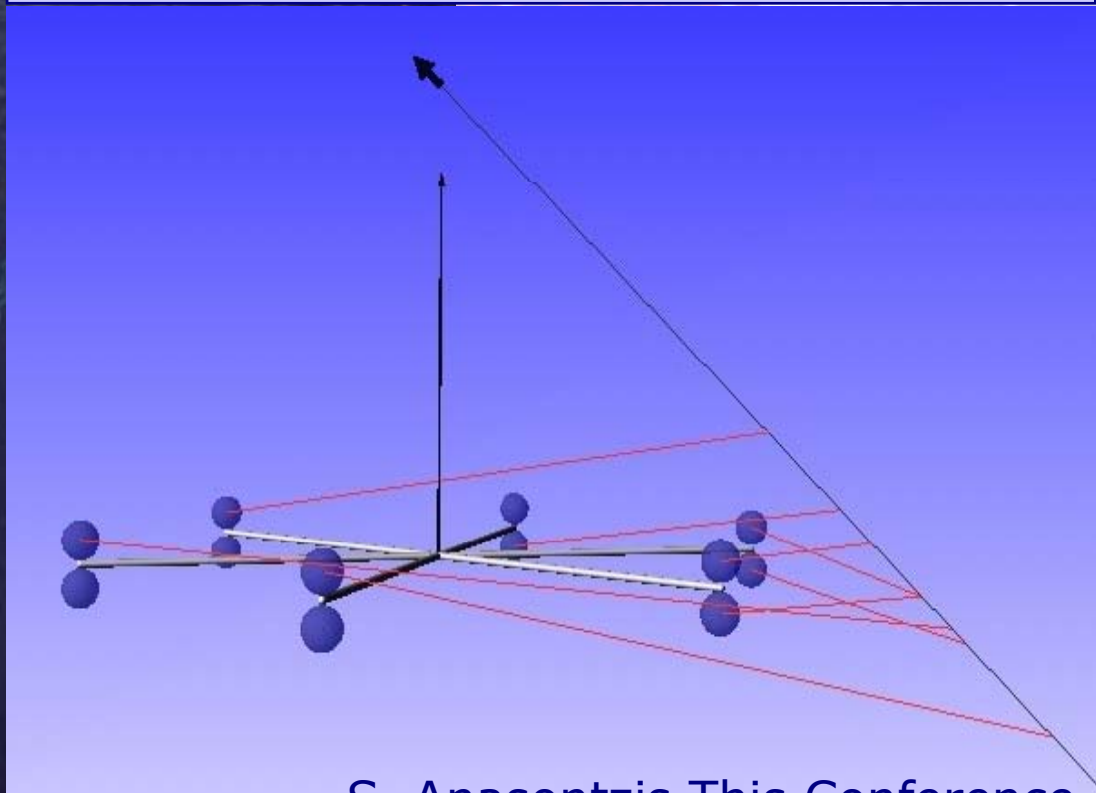


# The Nestor Project in Greece




Pictorial representation of a muon track (blue line).

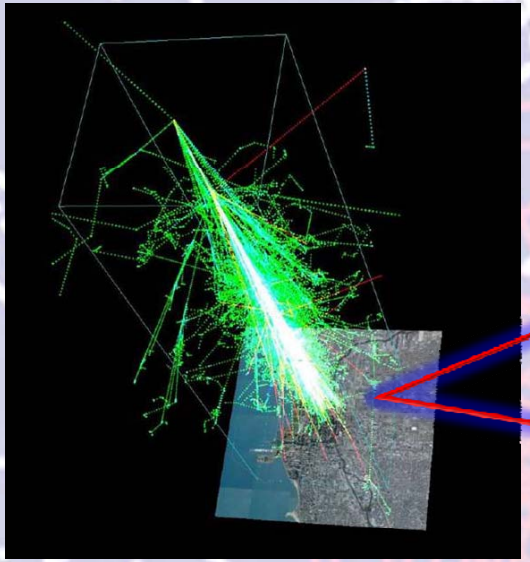
- Pink lines represent Cherenkov photons hitting the photomultipliers.
- Tracks coming from below could be attributed to neutrino

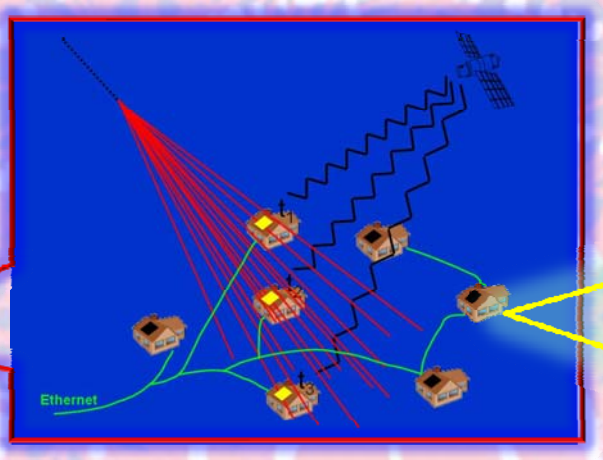


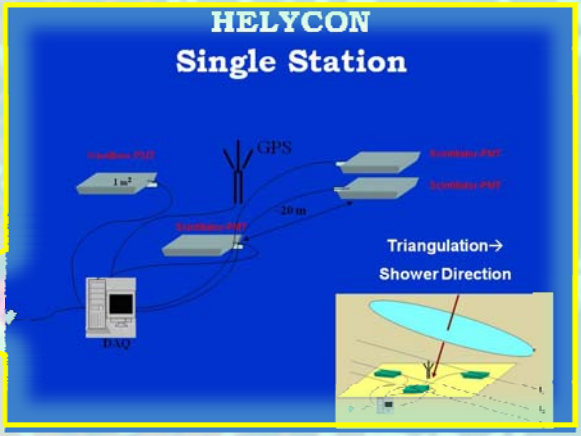
S. Anasontzis This Conference

# HELYCON

## Hellenic Lyceum Cosmic Observatories Network

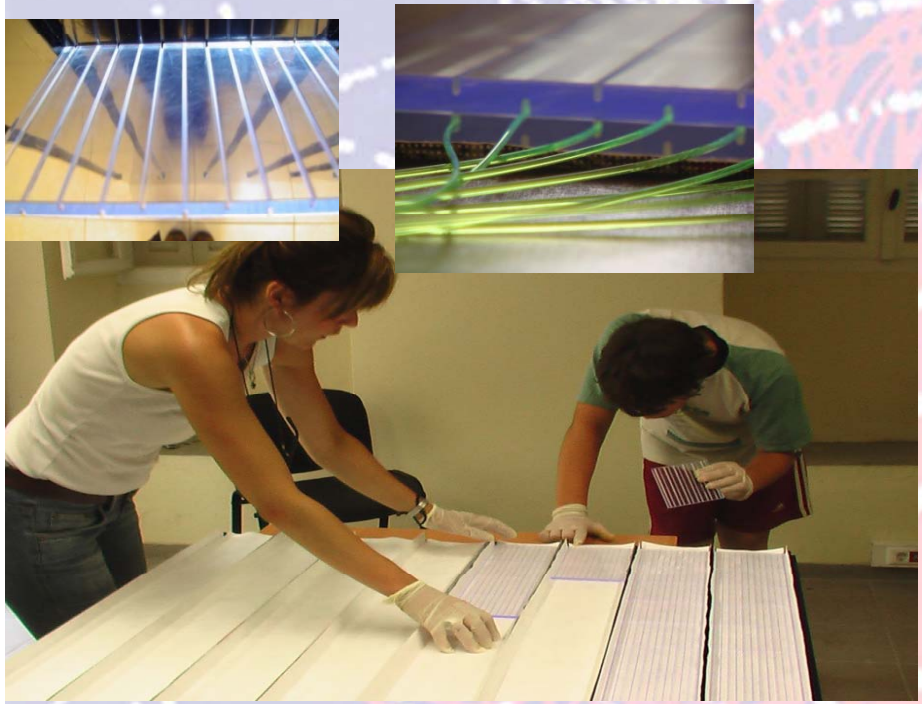


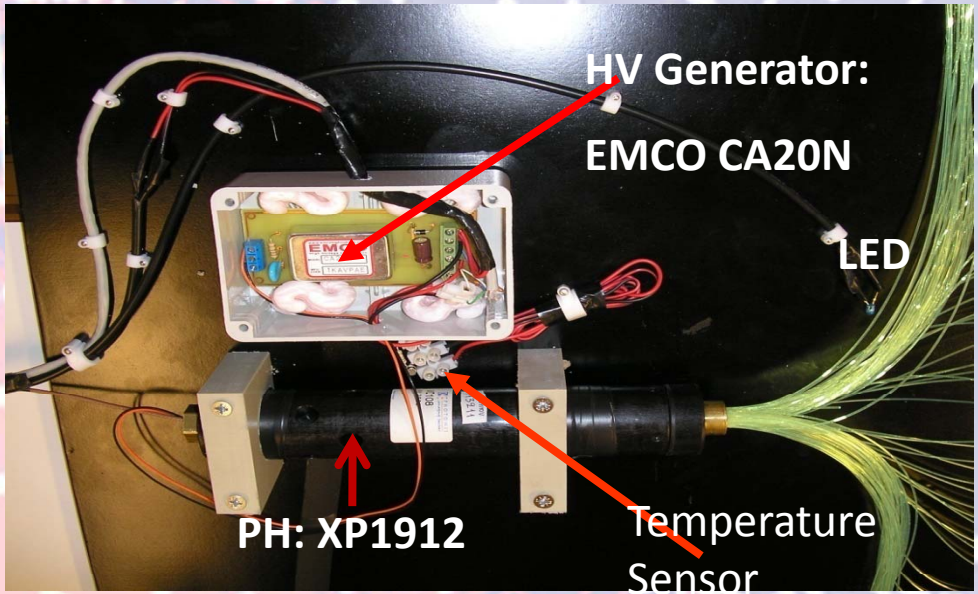


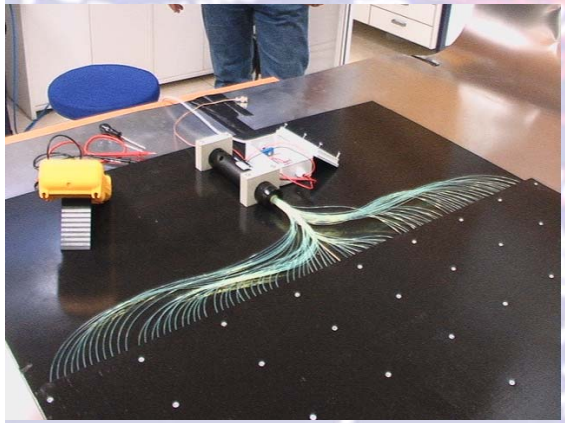





# HELYCON: Detector Construction





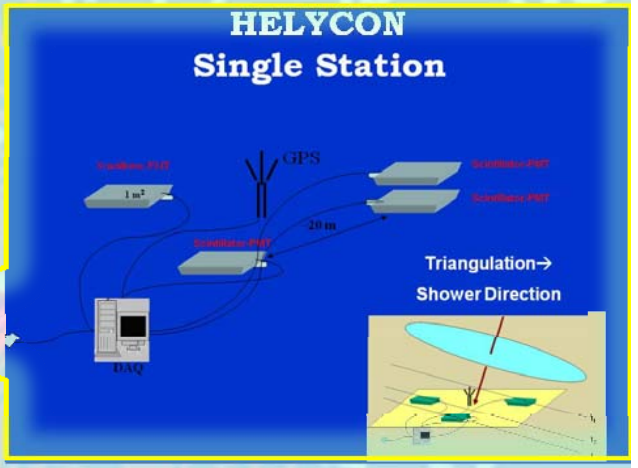
- Obtain direction of showers from time differences between stations
- Correlations between showers
- Flux of showers

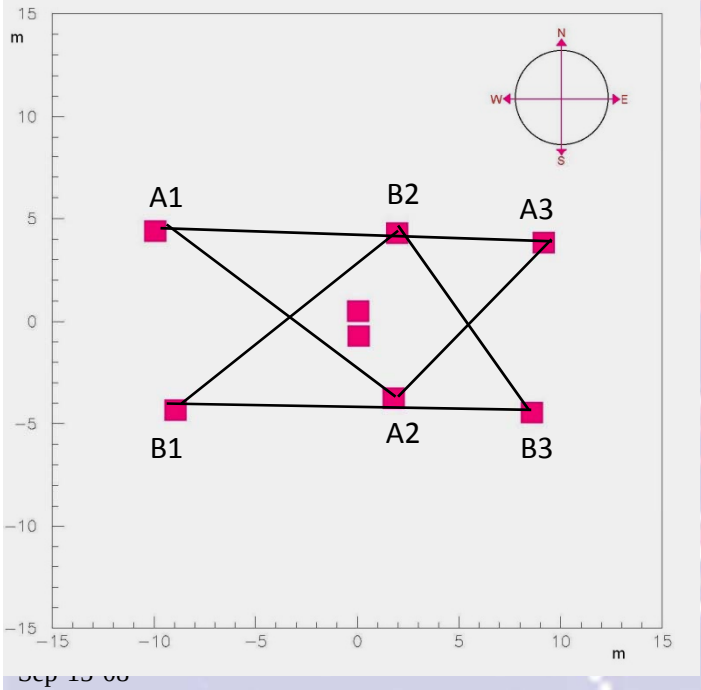
✓ Synchronization between stations achieved through GPS

# HELYCON: Testing and Shower Reconstruction

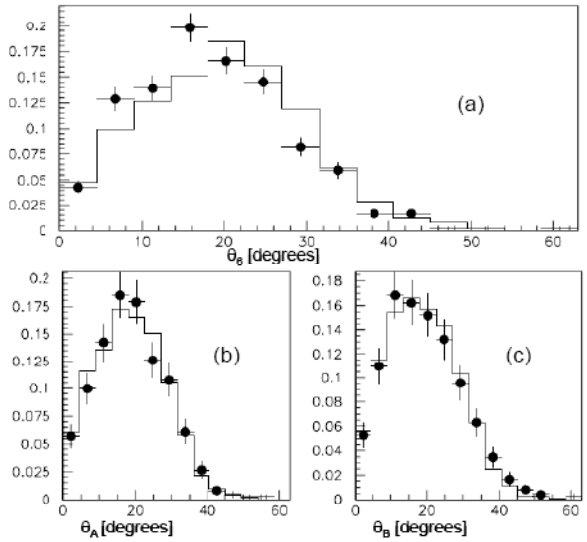
Single Station equipped :

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



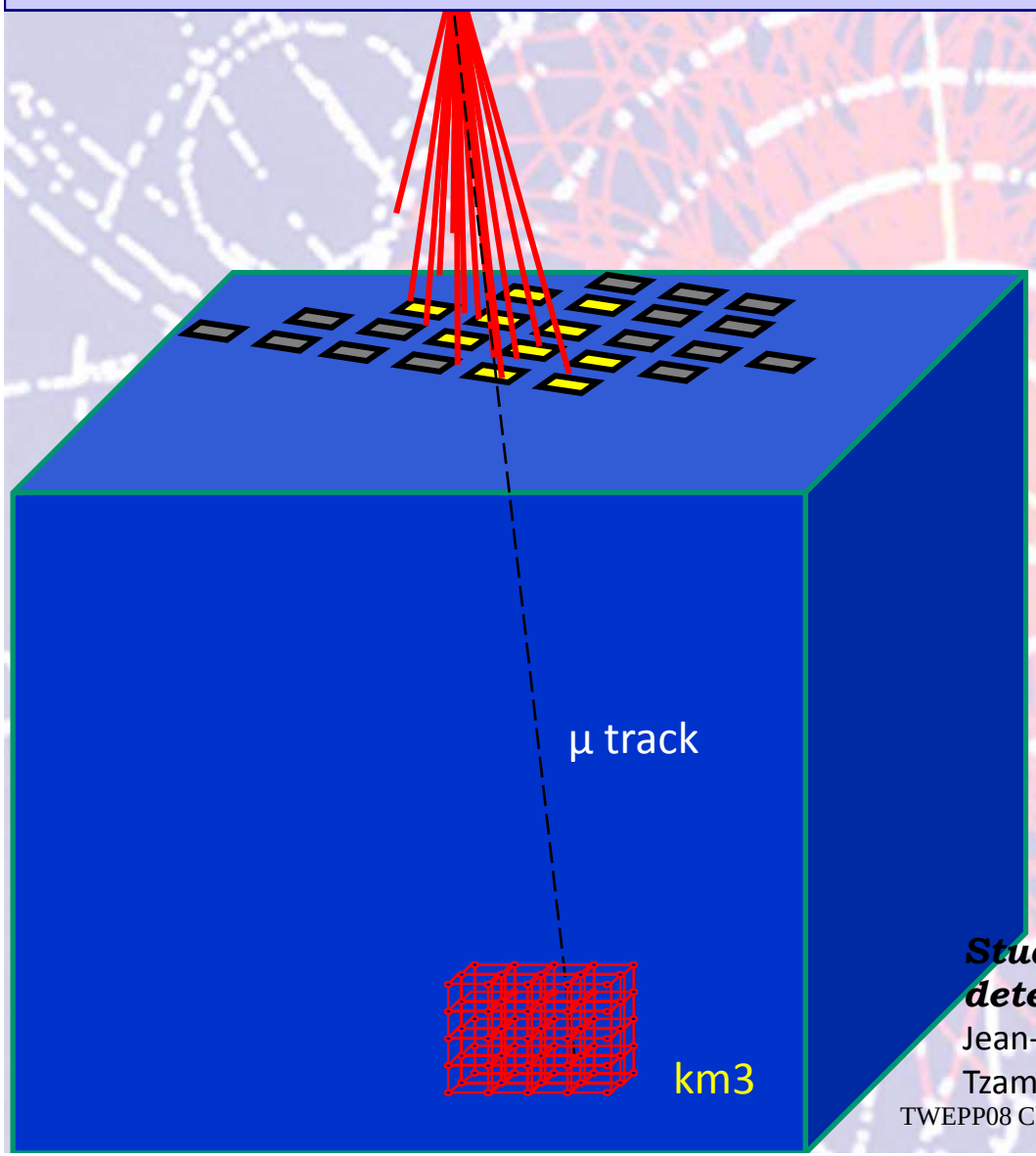

**Zenith angle distribution of reconstructed atmospheric showers (data points) with Monte Carlo (CORSICA, solid line) predictions using:** a) the detectors A1, A2, A3, B1, B2, B3, b) the counters A1, A2, A3 and c) using the counters B1, B2, B3

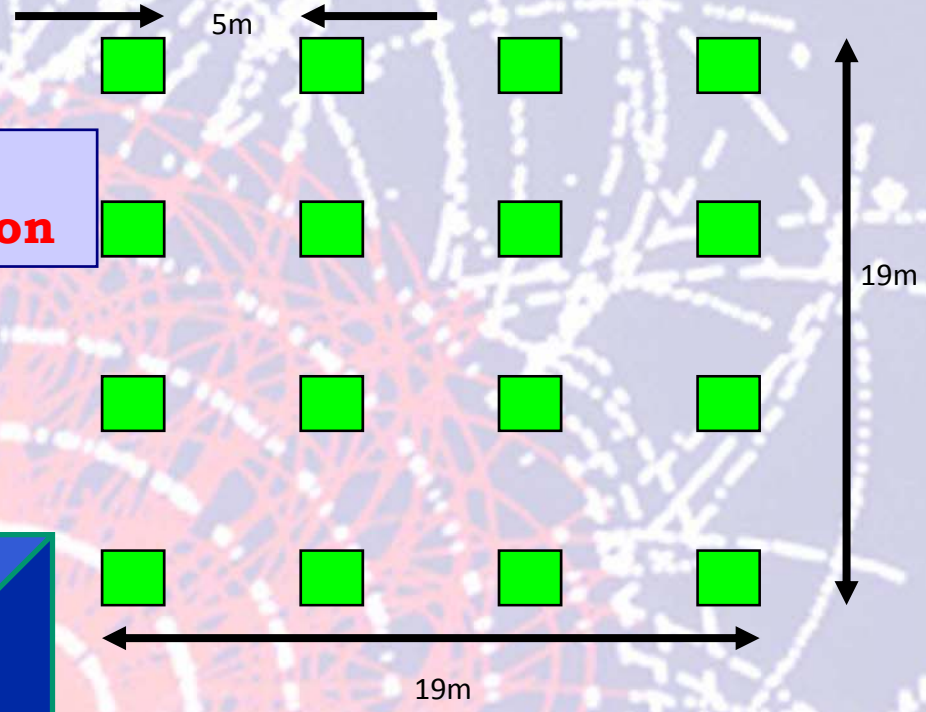


# HELYCON: Detector Deployment


| 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 0.05º calibration resolution in zenith angle** and less than **0.8m error in estimating the absolute position** of the neutrino telescope

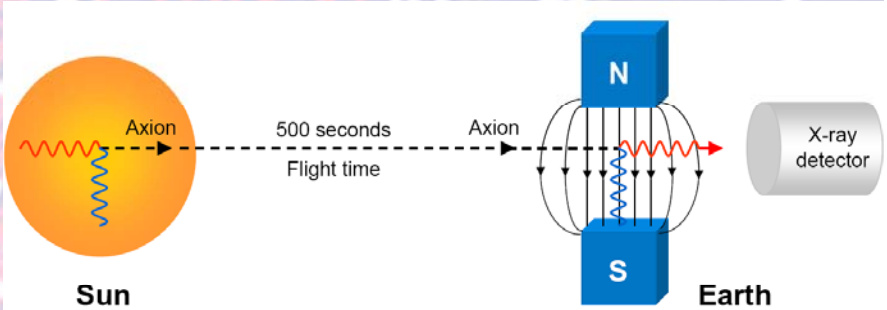
*KM3NeT:Conseptual Design for a Deep-Sea Research Infrastructure Incorporating a Very Large Volume Neutrino Telescope*

***Study of the calibration potential of HELYCON detectors with ANTARES***

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

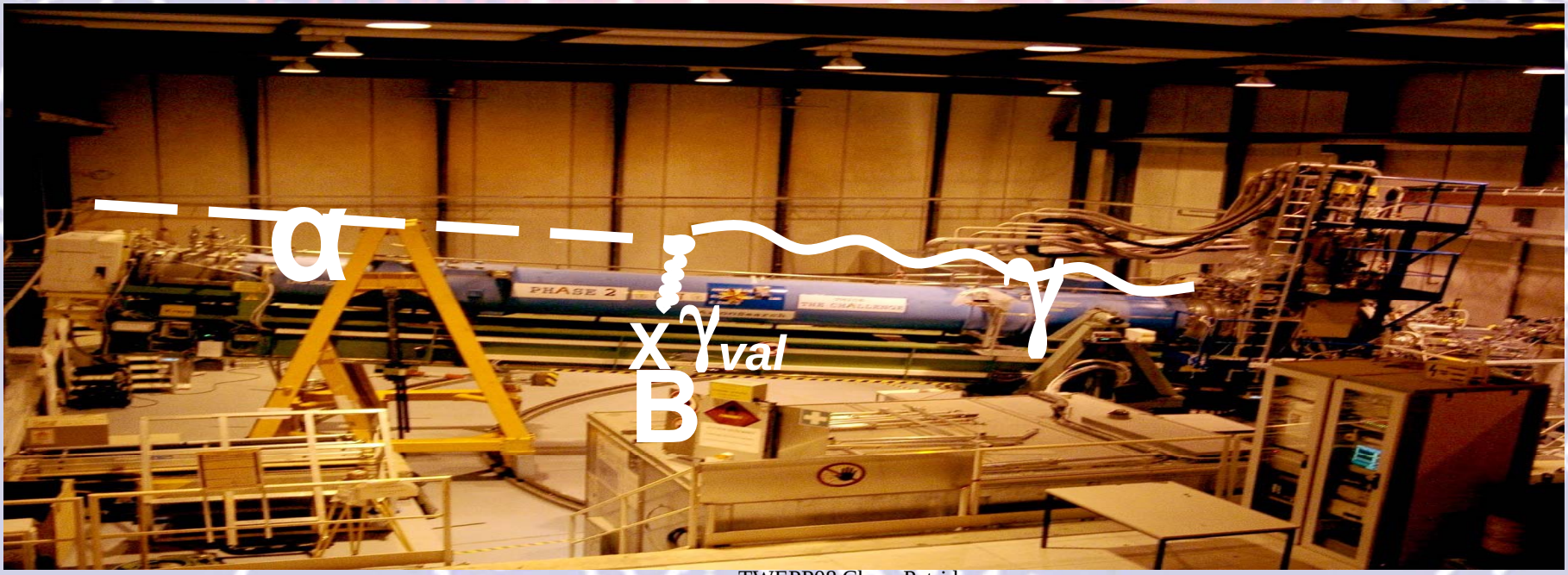
# CAST in Greece

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




*axion source*

*axion detection*



# 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**

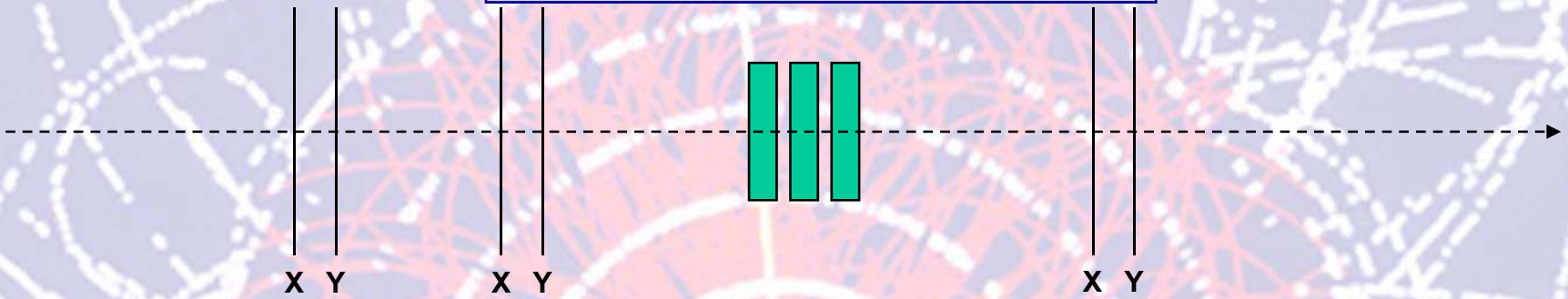
**Demokritos**

**Univ. of Athens**

**Univ. of Thessaloniki**

**Technical Univ. of Athens**

# The Telescope



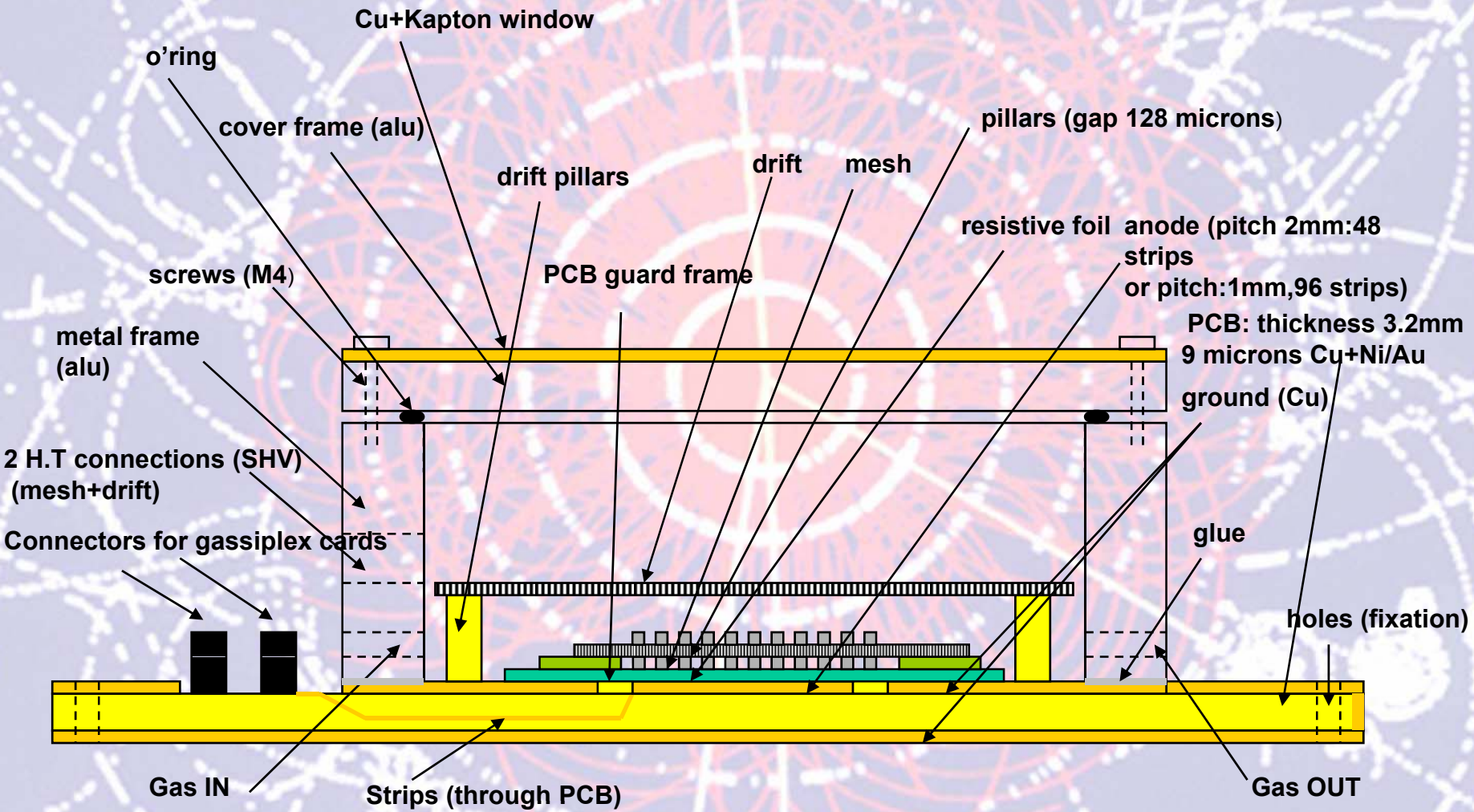

Detector parameters

- 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

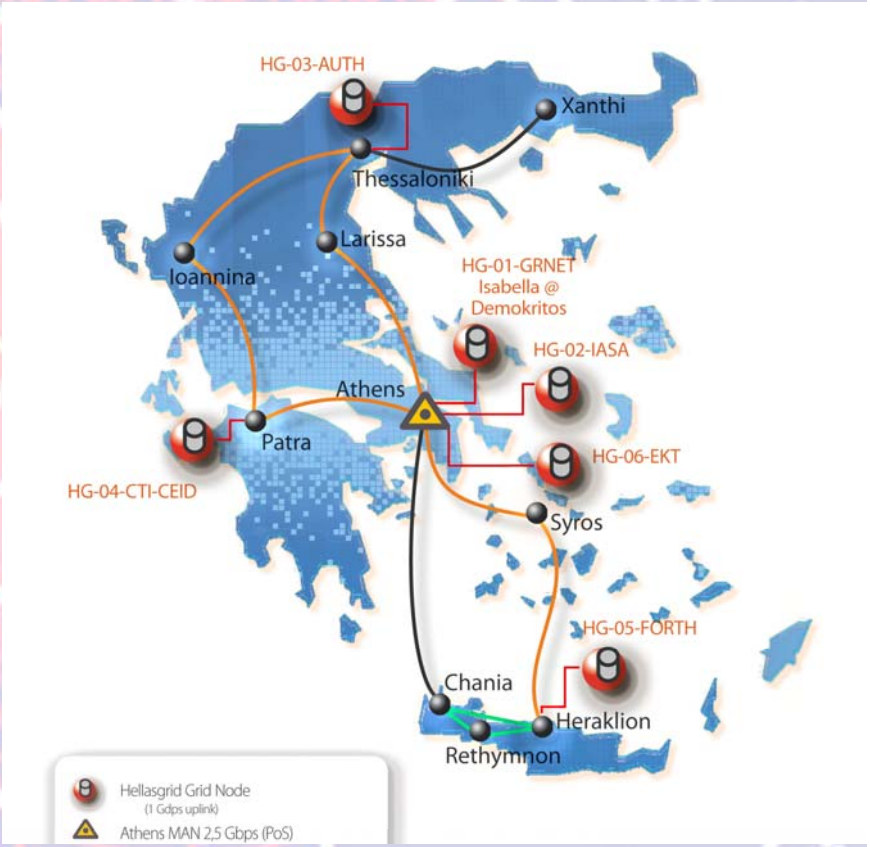


# Status

- 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



# BACKUP SLIDES

# Hardware Contributions of the NKUoA to ALICE

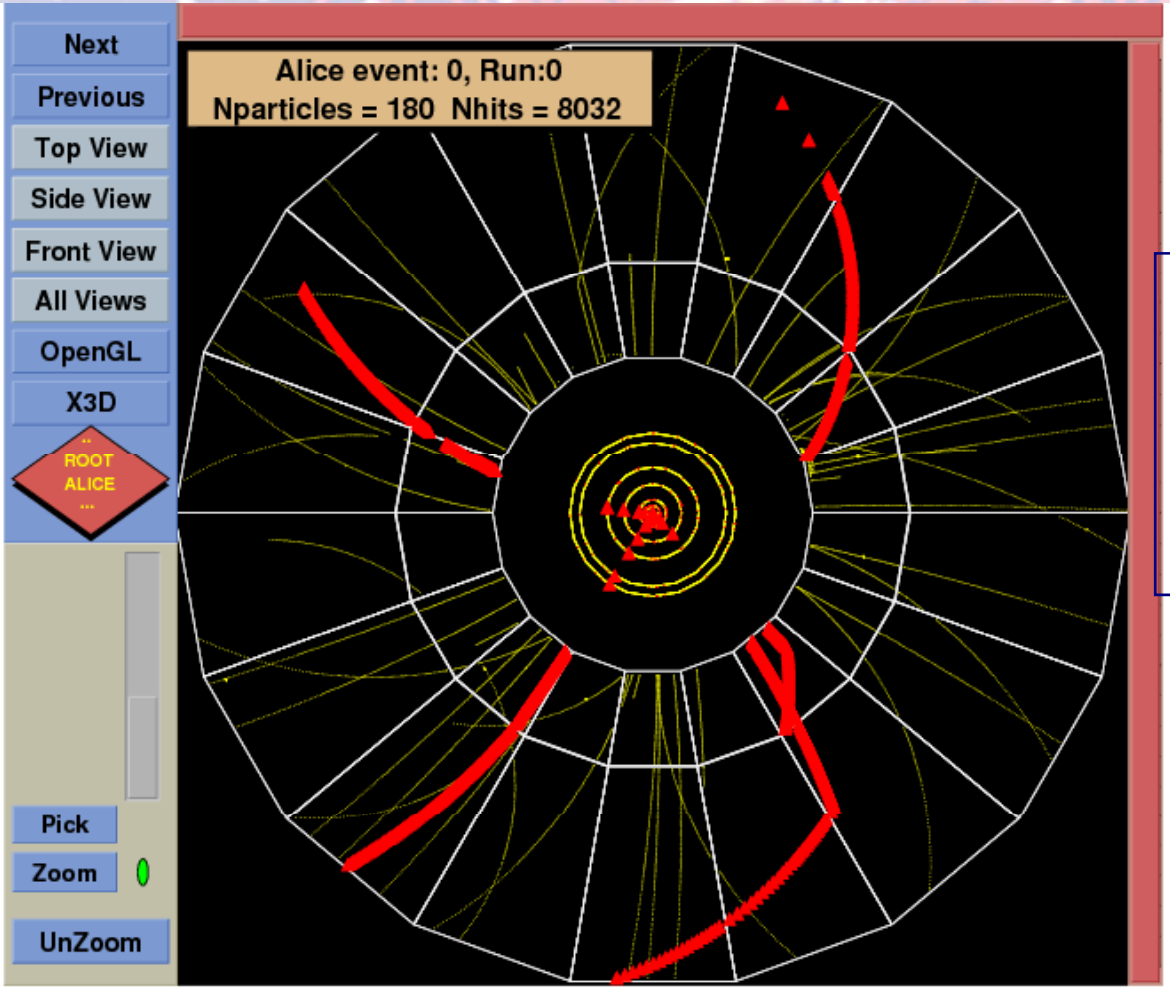
## HVDS Overview

High Voltage Distribution System:
- Simple design
  - Reduced complexity
  - Reduced number of components

- Very low current circuits:
  - Meet ALICE TRD requirements
  - Provide high resolving power (nA), fast response,
  - Short circuit protection

- Two Enfolded Voltage stabilizing Systems:
  - Shunt regulator
    - Provides load regulation
    - Reduces output ripple
  - Software regulation
    - Gives long term stability

# Contributions to Physics Analysis Software of the NKUoA to ALICE




K/π separation from their decays in the TRD detector

# 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**

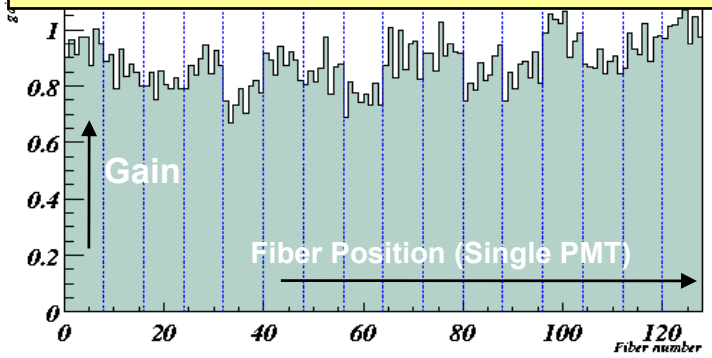
## NEAR MINOS DETECTOR

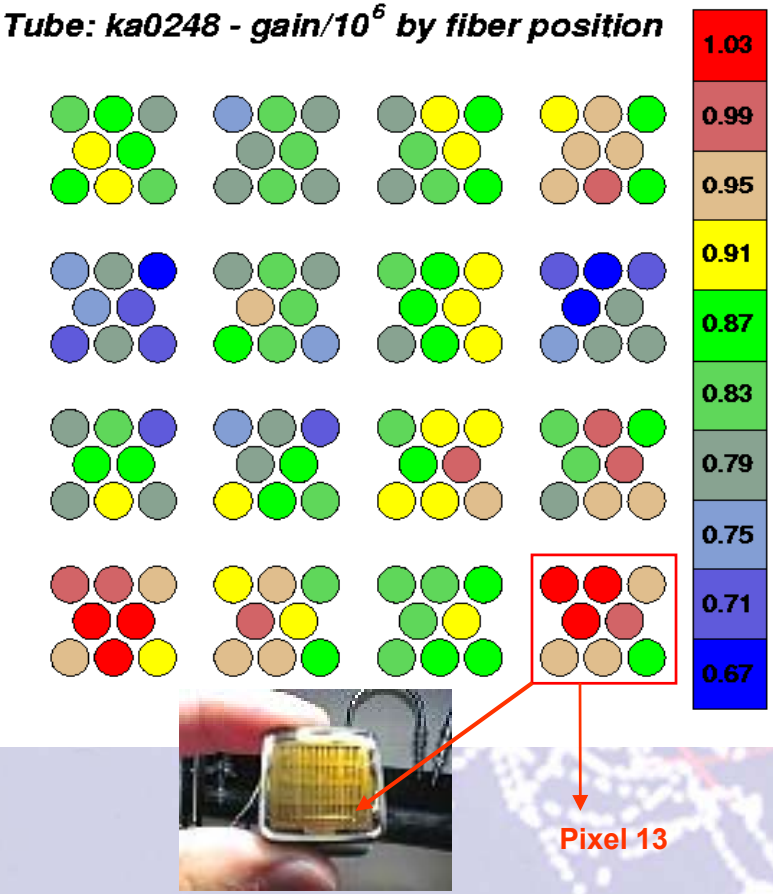
**Emulates the Far detector in absorber, active planes, and Bfield.**

**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

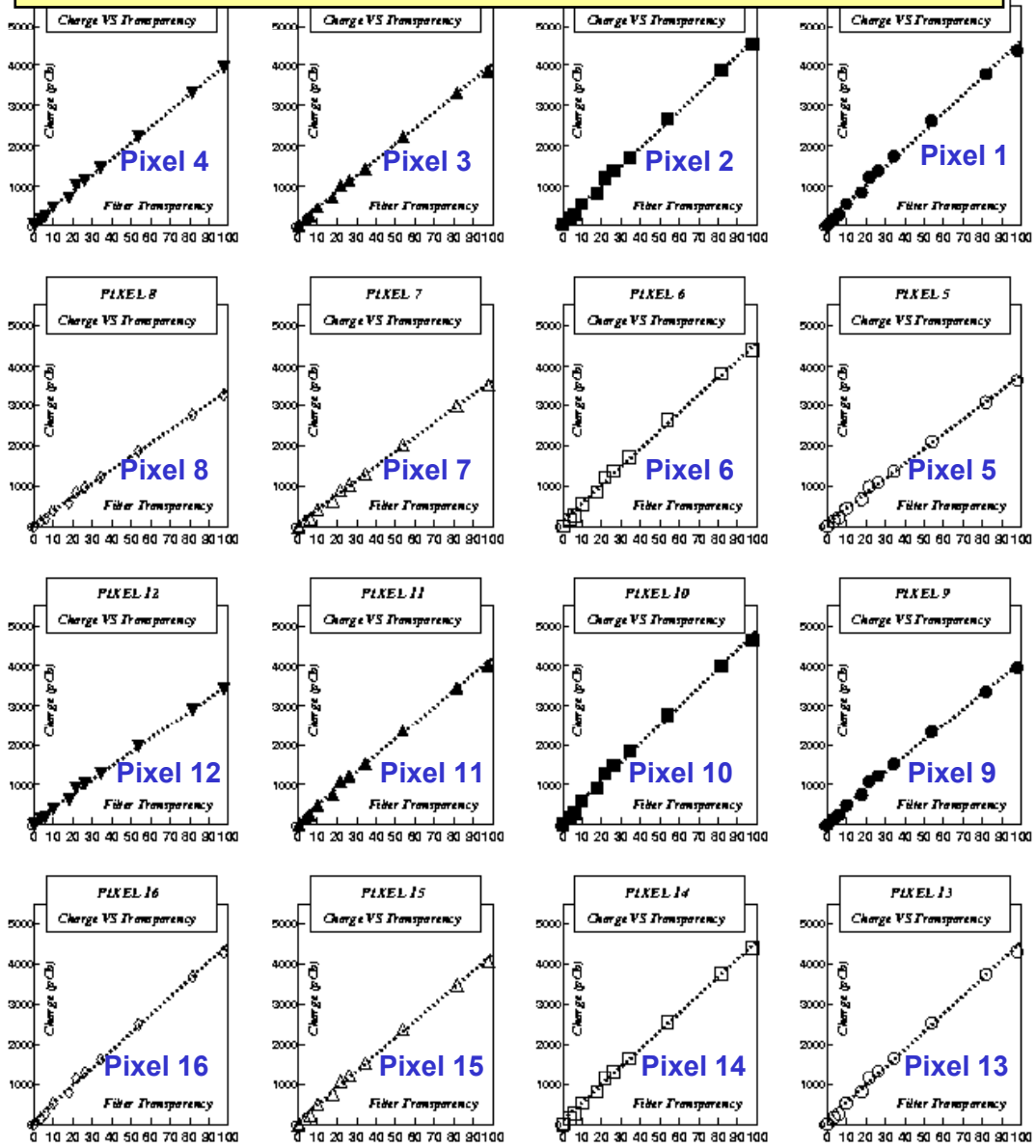
**Electronics: QIE chip based**

## Fiber Position Scan (Single PMT)



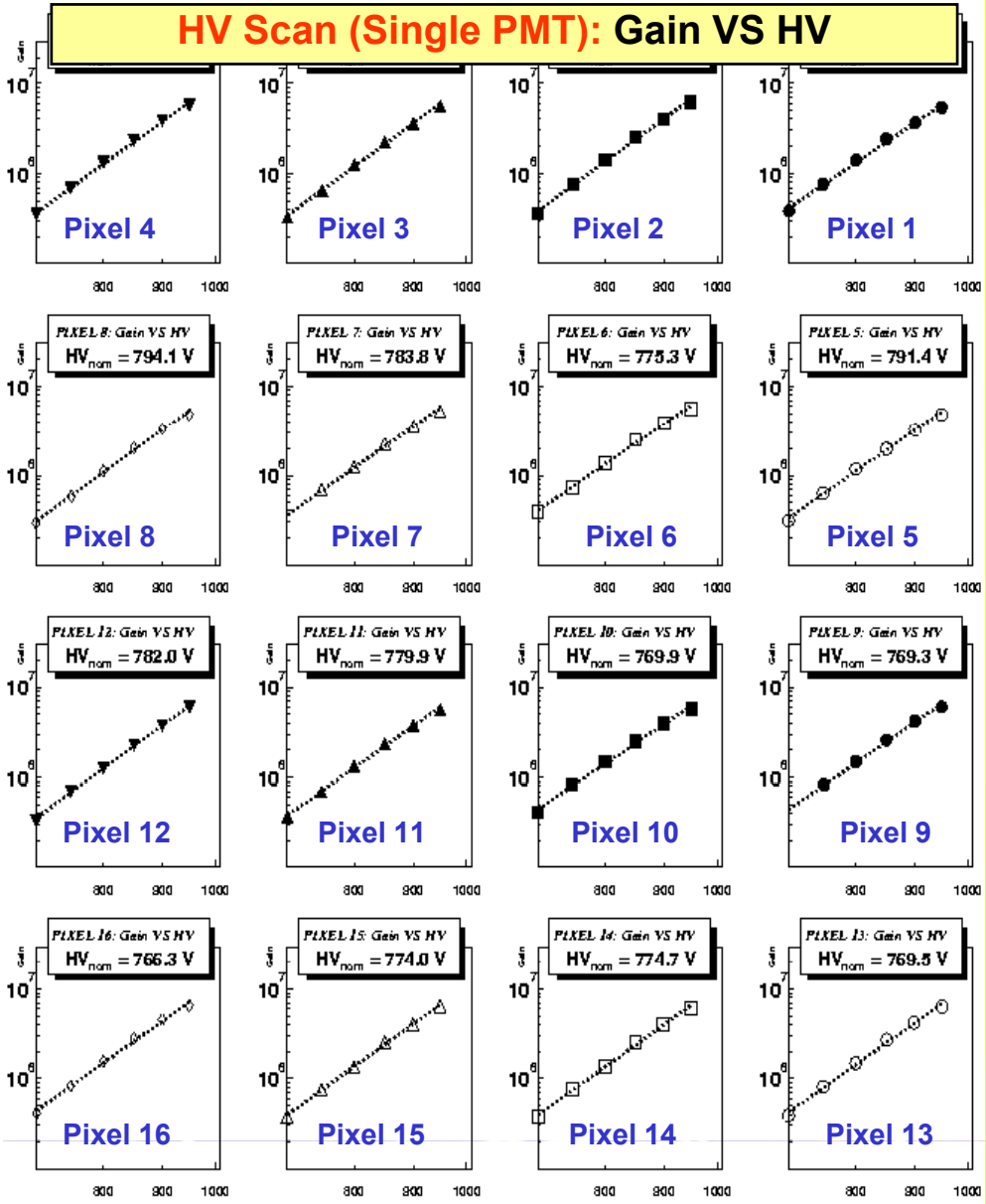




## Linearity Scan (Single PMT): Charge VS Light Level



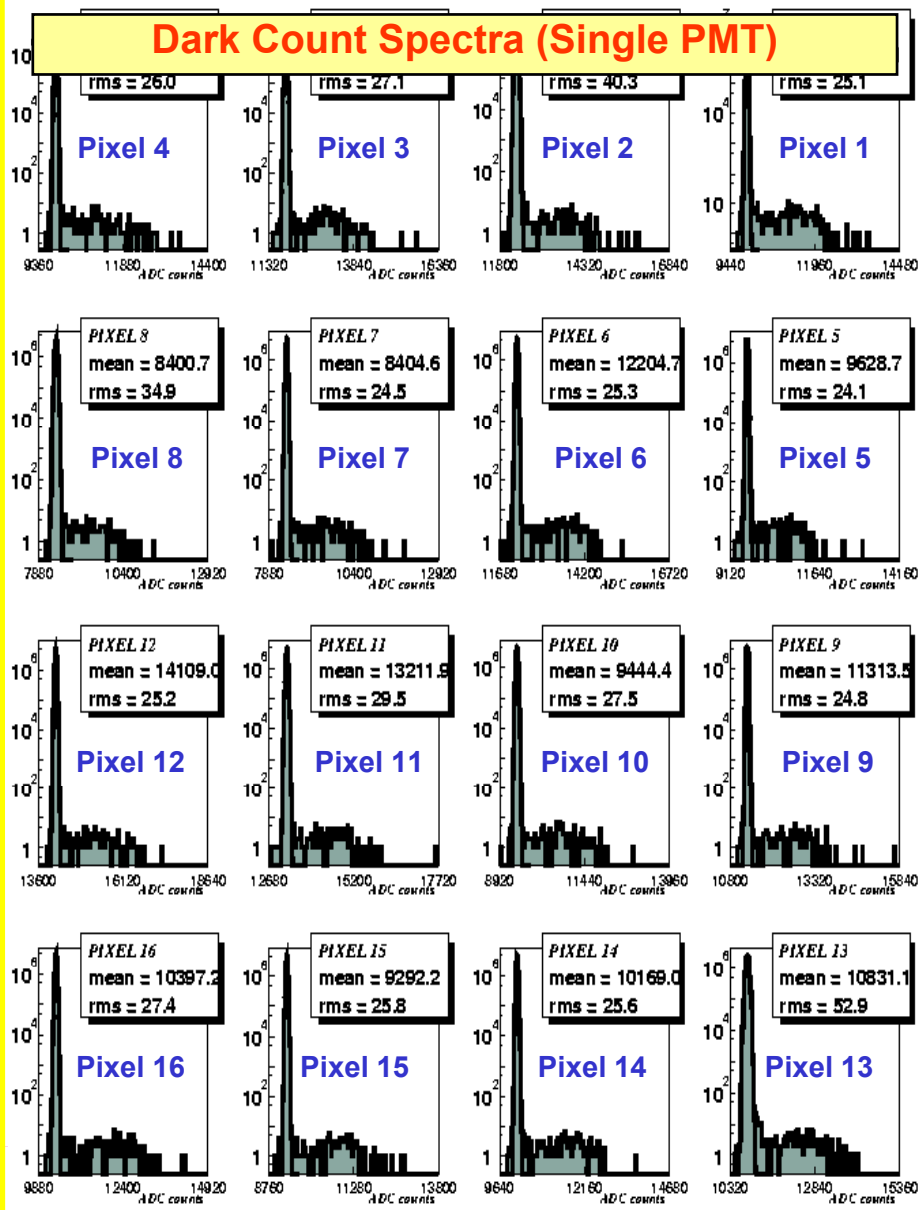

X-axis → neutral density filter transparency (%) ∝ light level

## HV Scan (Single PMT): Gain VS HV




X-axis → PMT High Voltage (Volts)

## Dark Count Spectra (Single PMT)

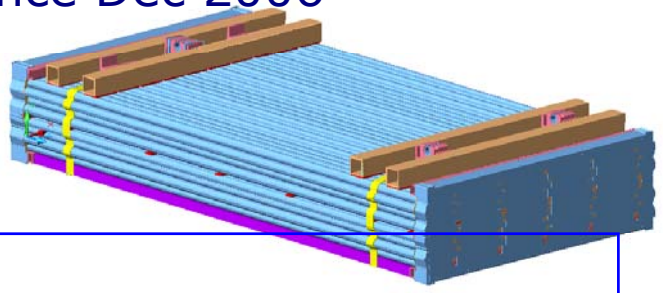



X-axis → ADC Counts ∝ anode charge (0.7 fC/count)

# The Greek ATLAS Project

**NKUoA, NTUA, AUTh** all three institutes collaborated in the construction of the **BIS 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



**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