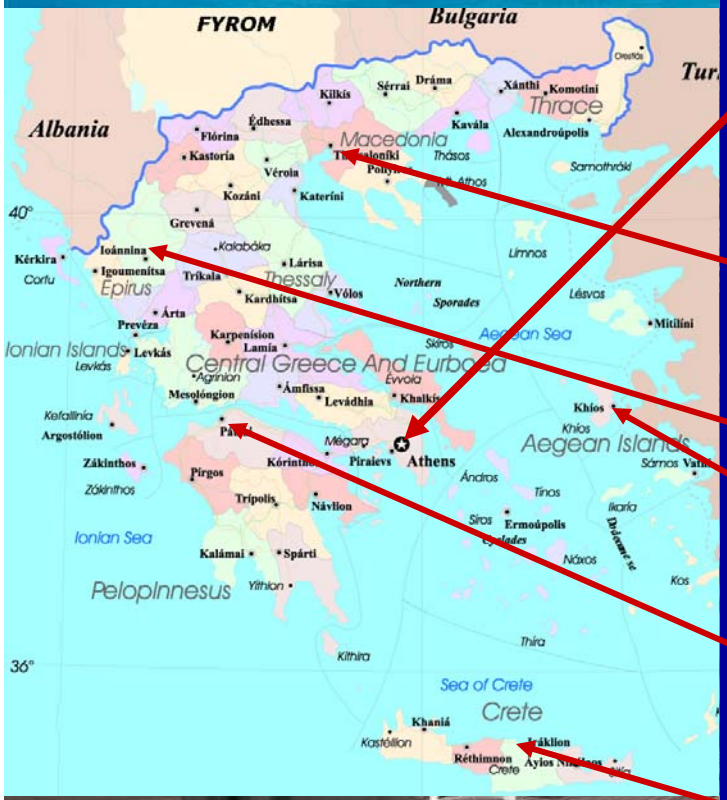
High Energy Physics ACTIVITIES @ GREECE

EVANGELOS N. GAZIS
National Technical University of Athens
Deputy Delegate at CERN

Subject : ***The Greek HEP activities : Present Status and Perspectives***

Friday 10 October 2008

Greek HEP Groups



LOCATION	GROUPS	EXPE-RIMENT	THEORY
ATHENS	NTU-A	X	X
	NCU-A	X	X
	DEMOKRITOS	X	X
NORTH GREECE	Aristotle University THESSALONIKI	X	X
WEST	IOANNINA	X	X
EAST	AEGEAN (CHIOS)	X	
SOUTH	PATRAS	--	X
	OPEN UNIV.	X	--
	CRETE	--	X

Greek HEP Researchers

	Staff			Post-Docs		Graduate Students	
Institution	**EXP**	**THEORY**	**ENG**	**EXP**	**THEORY**	**EXP**	**THEORY**
NTU-A	9	7	11	2	2	10	5
NCUA	16	12	2	3	6	14	12
DEMO-KRITOS	10	5	3	2	2	4	3
AUTH	8	9	2		2	5	4
IOANNINA	5	8			1	2	3
AEGEAN	1						
PATRAS OPEN U.	1	2		3		2	
CRETE	1	6			7		3
Total	**51**	**49**	**18**	**10**	**20**	**37**	**30**

SUMMARY of Greek HEP people

- ✓ 100 Staff
- ✓ 30 Post-Docs
- ✓ 67 Graduate Students
- ✓ 13 Engineers
- ✓ 15 technicians

TOTAL PEOPLE : 228 + ~5 PhD's/year

LHC Experiments + Others

ATLAS (AU-THessaloniki, NCU-Athens, NTU-Athens)

CMS (NCUA, IOANNINA, DEMOKRITOS)

Detector Construction

ALICE (NCUA)

CAST (AUTH, DEMOKRITOS, PATRAS)

N-TOF (AUTH, NTUA, UoI, DEMOKRITOS)

N-TOF

AUTH, NTUA, UoI, DEMOKRITOS
(TANDEM LAB)

FNAL : MINOS, CDF (NCUA)

DESY : ZEUS (UoAegean), **H1** (NTUA)

NON-ACCELERATOR GROUPS : NESTOR

HELYCON (HOU) **AUGER** (NTUA, NCUA)

Detectors R&D + Accelerators

LHC CRYOGENICS : (NTU-Athens, TEI-Ath, TEI-Peiraus)

12 Enginners for 2006-2008

S-LHC MicroMegas Detector : (AUTH-essaloniki, NCU-Athens, NTU-Athens, DEMOKRITOS)

CLIC : a kick startup

- **1 PhD student** (NTU-Athens)
- **2 Summer Students** (UoPatras)
- **MoU** (under signature)

Medical Appl. : Proton Therapy study group

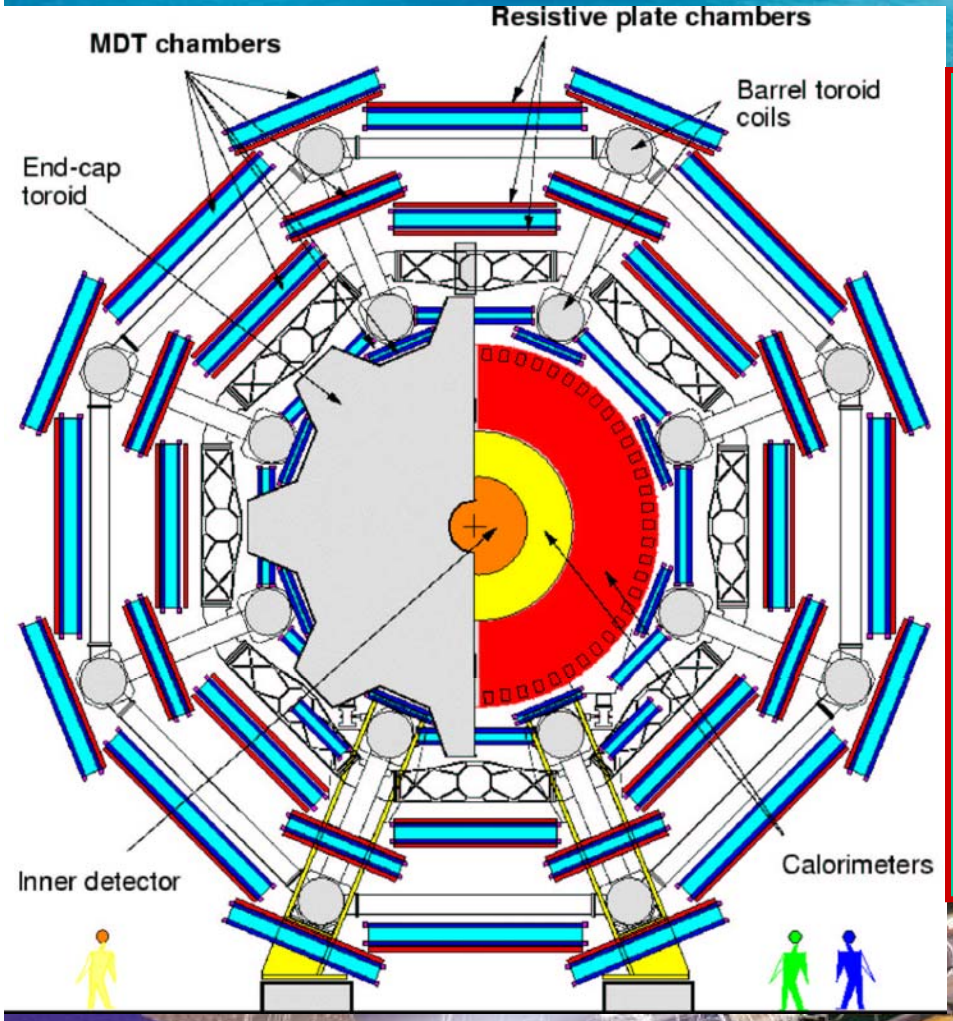
- **1 MSc student** (NTU-Athens)
- **MoU** (under signature)

Theory

~ 65 Ph.D's in total

Phenomenology :	UoA, NTUA, D, UoI, AUTH, UoC, UoPatras
Strings :	UoA, NTUA, Democr., UoI, UoC, UoPatras
SM+extensions :	UoA, NTUA, UoI, AUTH
Cosmology :	UoA, NTUA, Democritos, UoI, AUTH, UoC
Quantum Gravity :	UoA, Demokritos, UoI
EW + ν's :	UoI, AUTH

The Greek ATLAS Muon Chambers (MDT-BIS)



The Greek ATLAS "consortium"

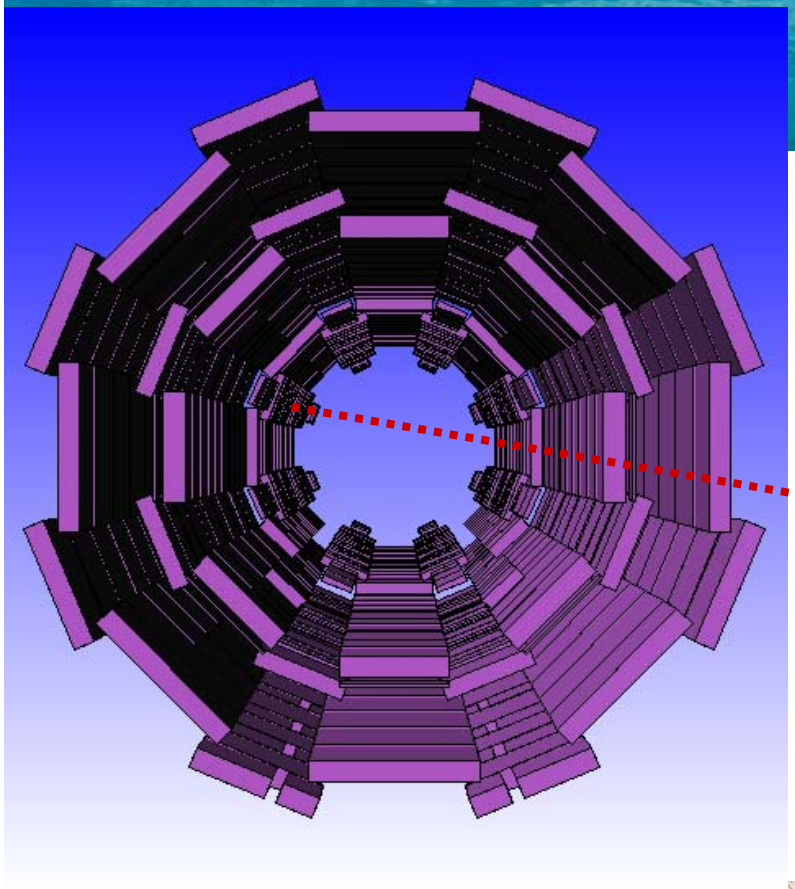
(Construction @ GREECE : 1999-2004)

NCUA : MDT tube assembly (30 000)

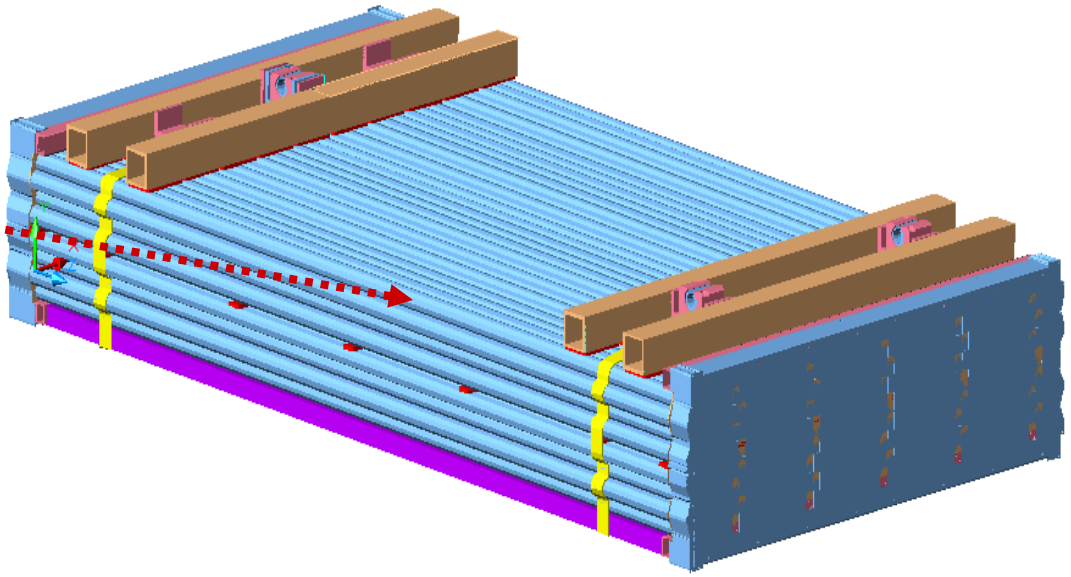
NTUA : QA_QC of MDT tubes (30 000)

AUTH : Chambers assembly (112)

The Greek ATLAS Muon Chambers (MDT-BIS)

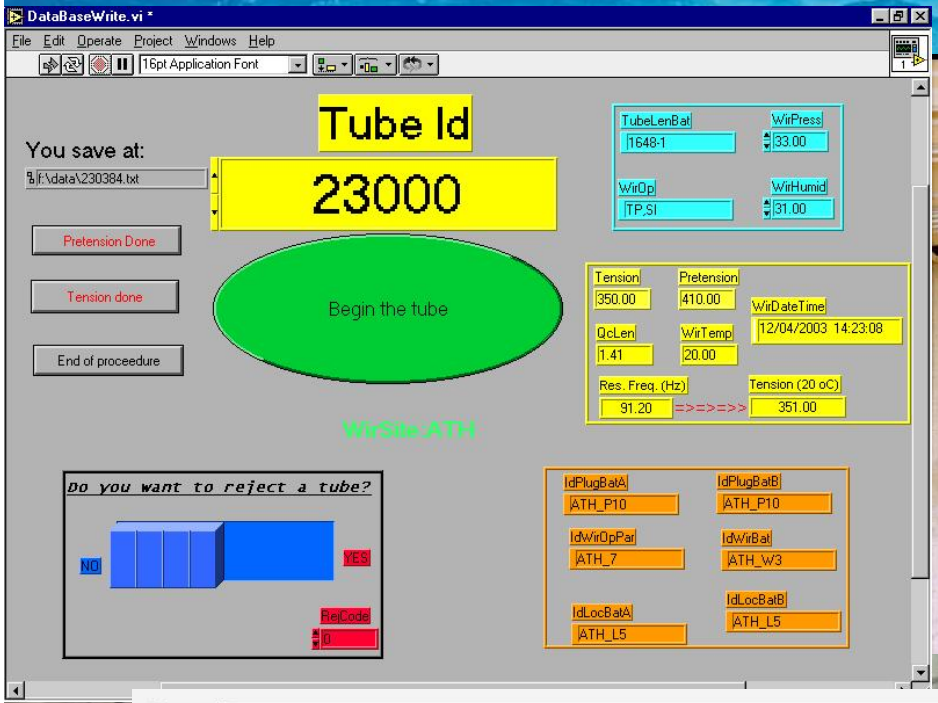


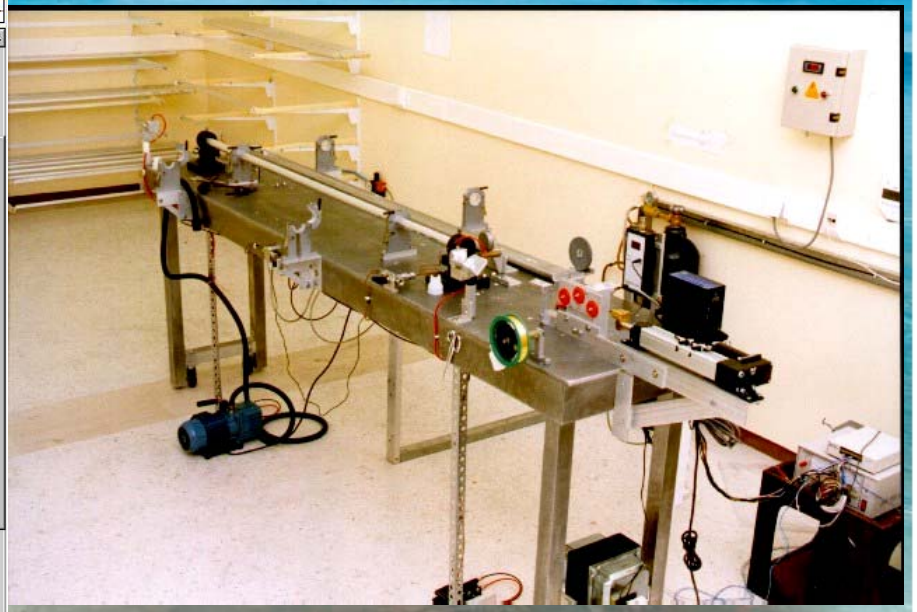
Barrel Inner Small chambers

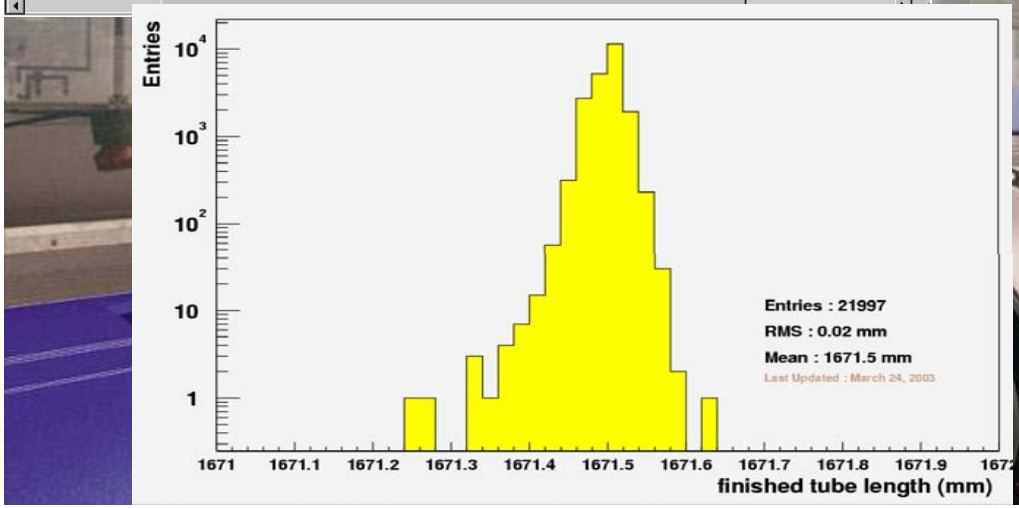


The University of Athens (NCUA)

The tube assembly facility



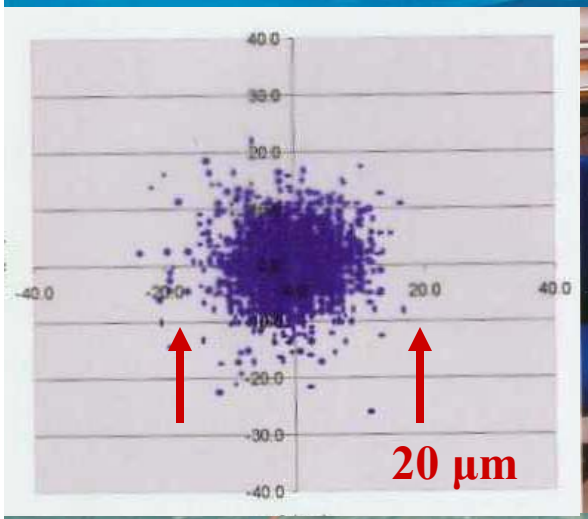


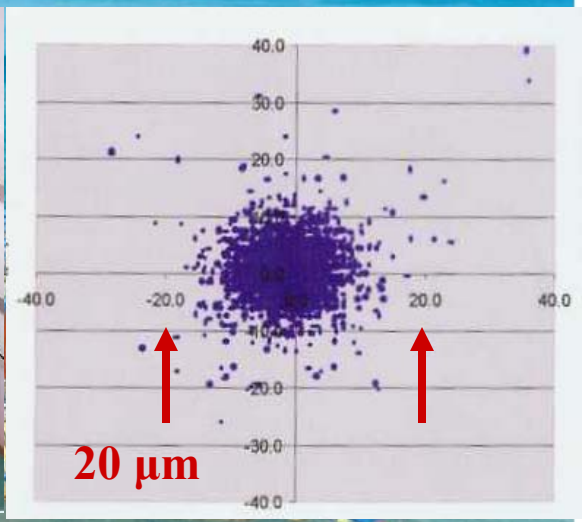


The Technical University of Athens (NTUA)

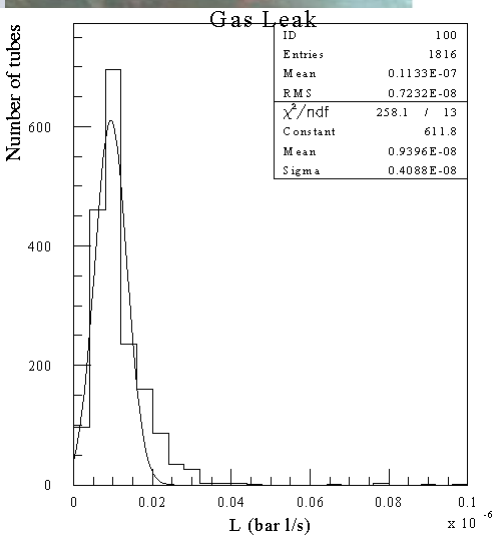
The QA_QC tube facility

Wire position measurement





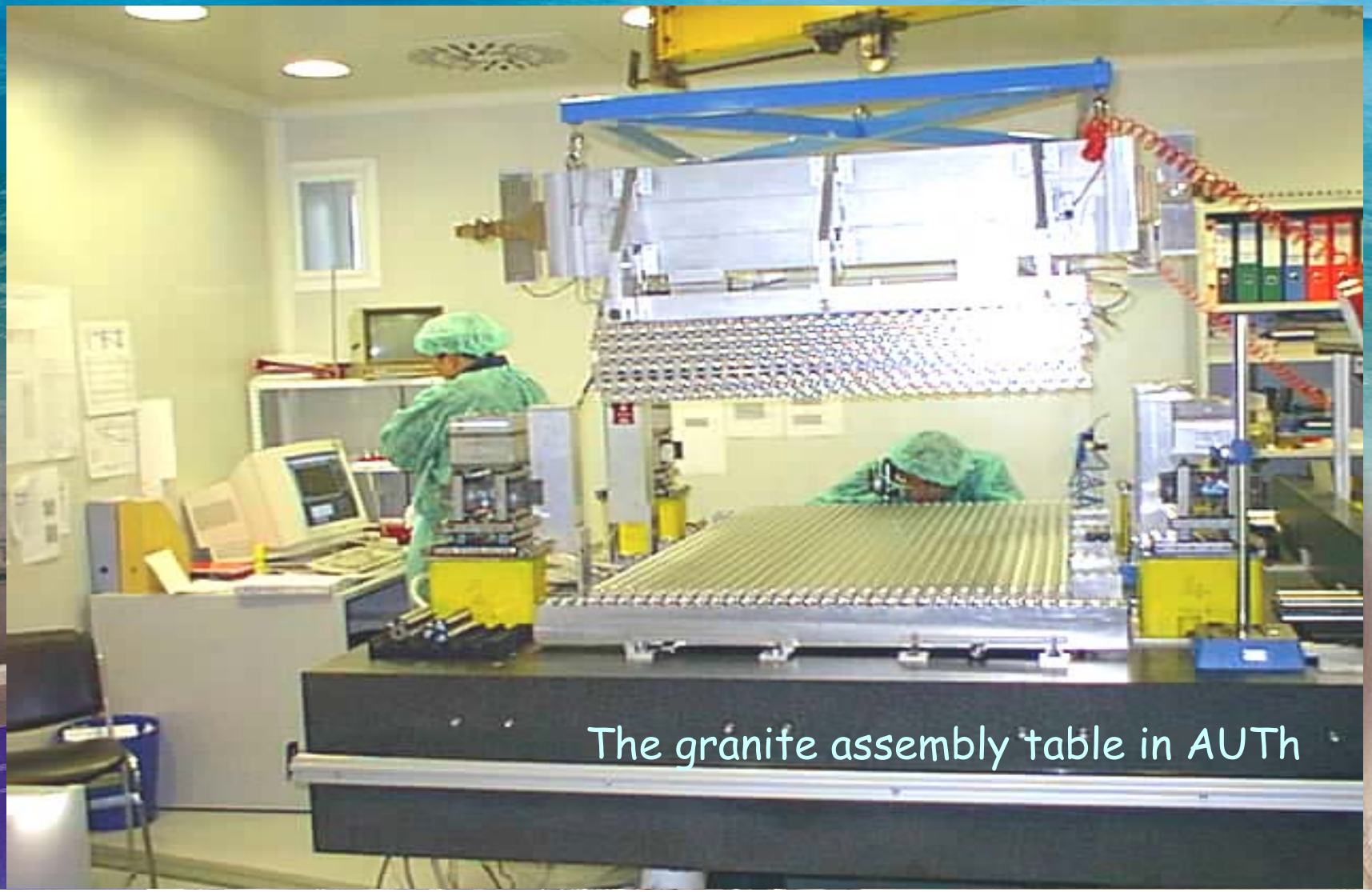
Gas Leak rate measurement



The Aristotle University of Thessaloniki (NTUA)

The MDT chamber construction

Class 50000, Temperature ±0.5°C, Humidity ±5 %



The granite assembly table in AUTh

Greek Delegation to CERN

D.V. Nanopoulos & ENG

(CERN : 2004-2005)

112 +16 MDT-Chambers for integration and test finished!

July 2005

READY FOR INSTALLATION!

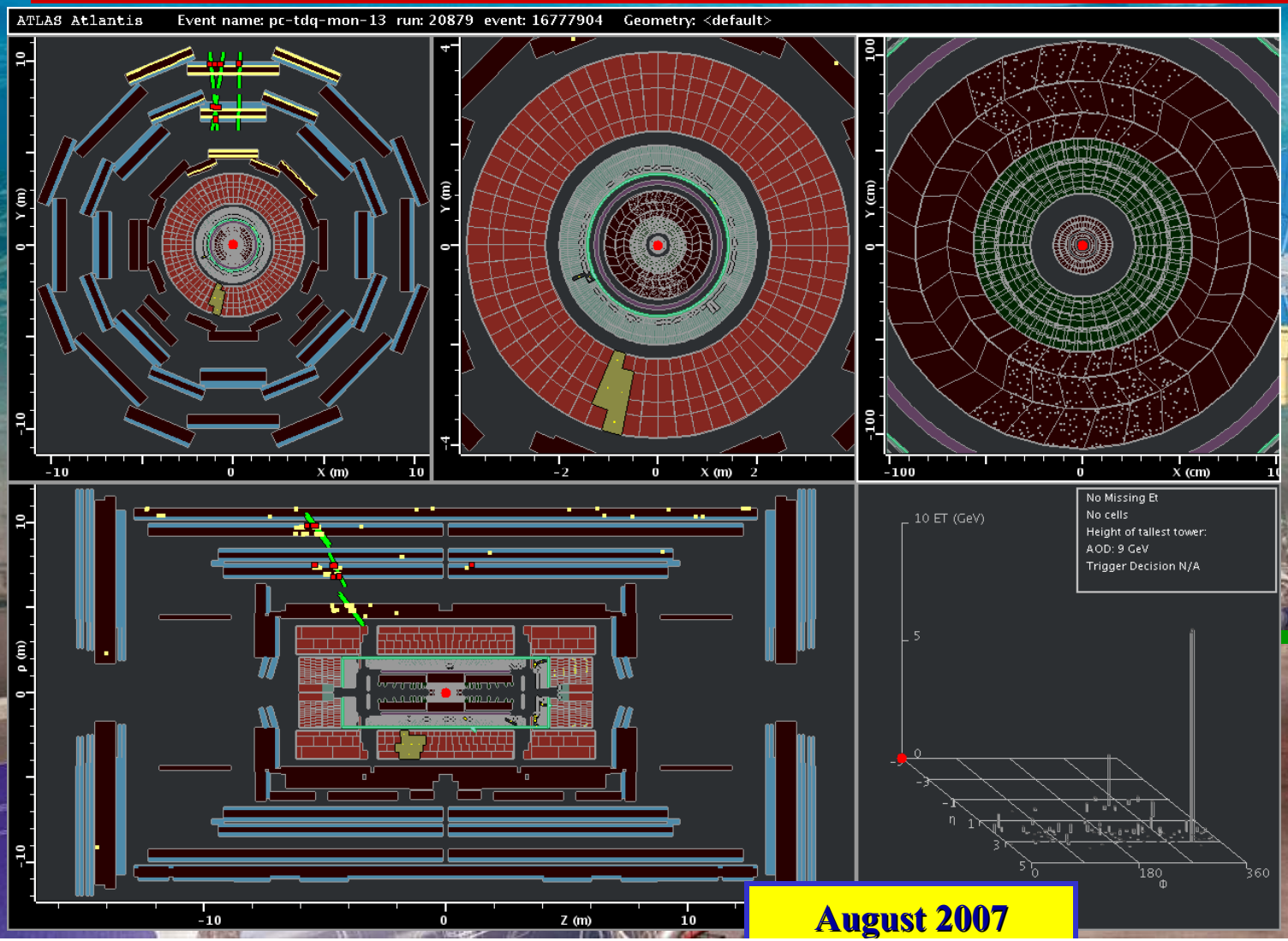
INSTALLATION in ATLAS

March-Dec 2006 !!

Commissioning with Cosmics

S. Vlachos, ATLAS Muon Run Coordinator/NTU_Athens

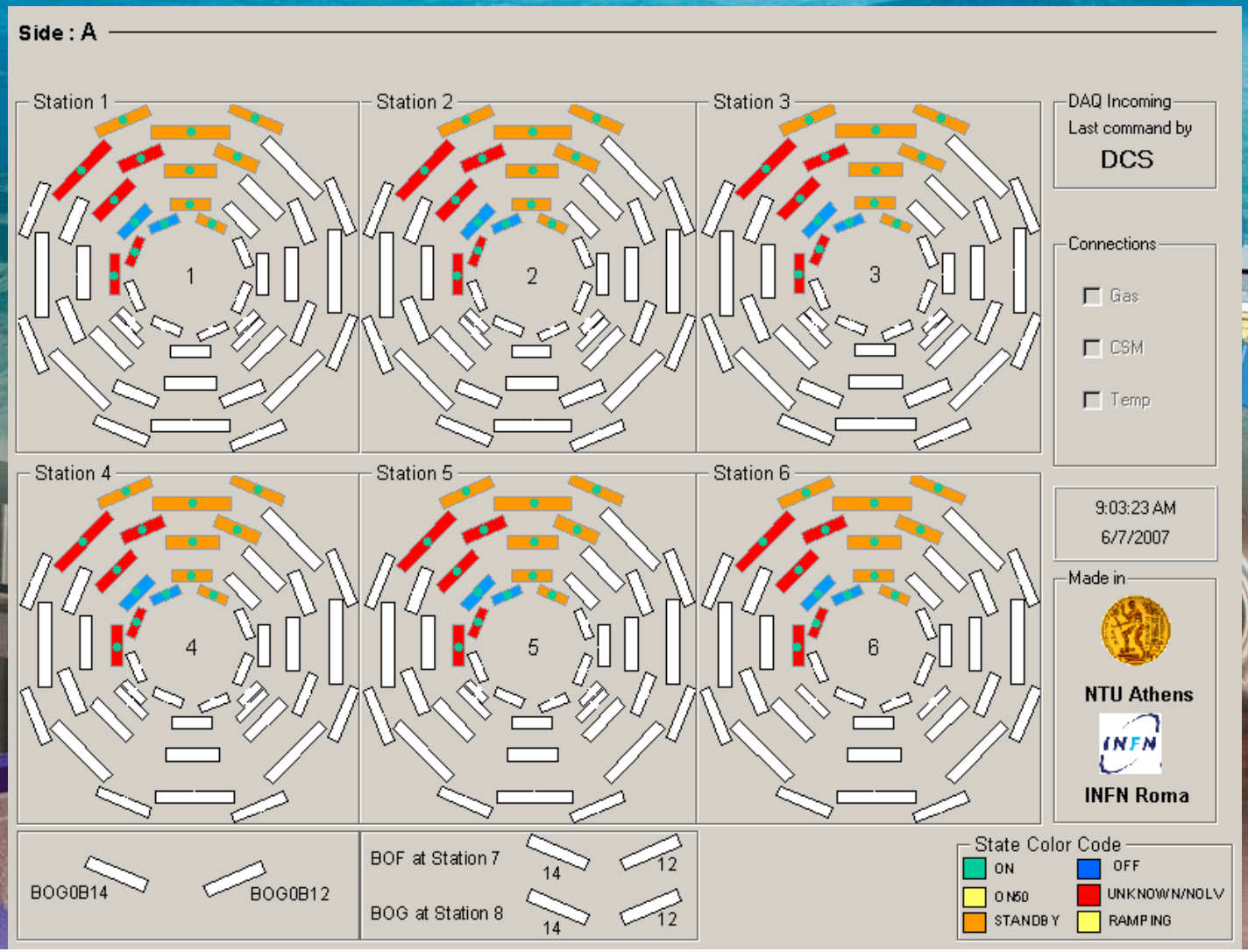
Jan 2006-Aug 2008



August 2007

ATLAS DCS Power Supply
NTUA-Rome Project

- **April 2007-June 2008:**
  - **Successful setup for monitoring all connected chambers**



Current research activities of the ATLAS Greek groups

- Commissioning of the MDT Chambers — UoA, NTUA, AUTh
- Commissioning of the CSC Chambers — UoA, NTUA
- DCS and HV/LV, Bfield control for MTD's — NTUA
- Muon Track Reconstruction — NTUA
- Data Quality Assessment software development — AUTh
- Cosmic ray runs for the detector commissioning — AUTh, NTUA
- Development of microMegas for SLHC — UoA, NTUA, AUTh
- Physics studies — UoA, NTUA, AUTh

The Greek CMS Project

Pre-shower

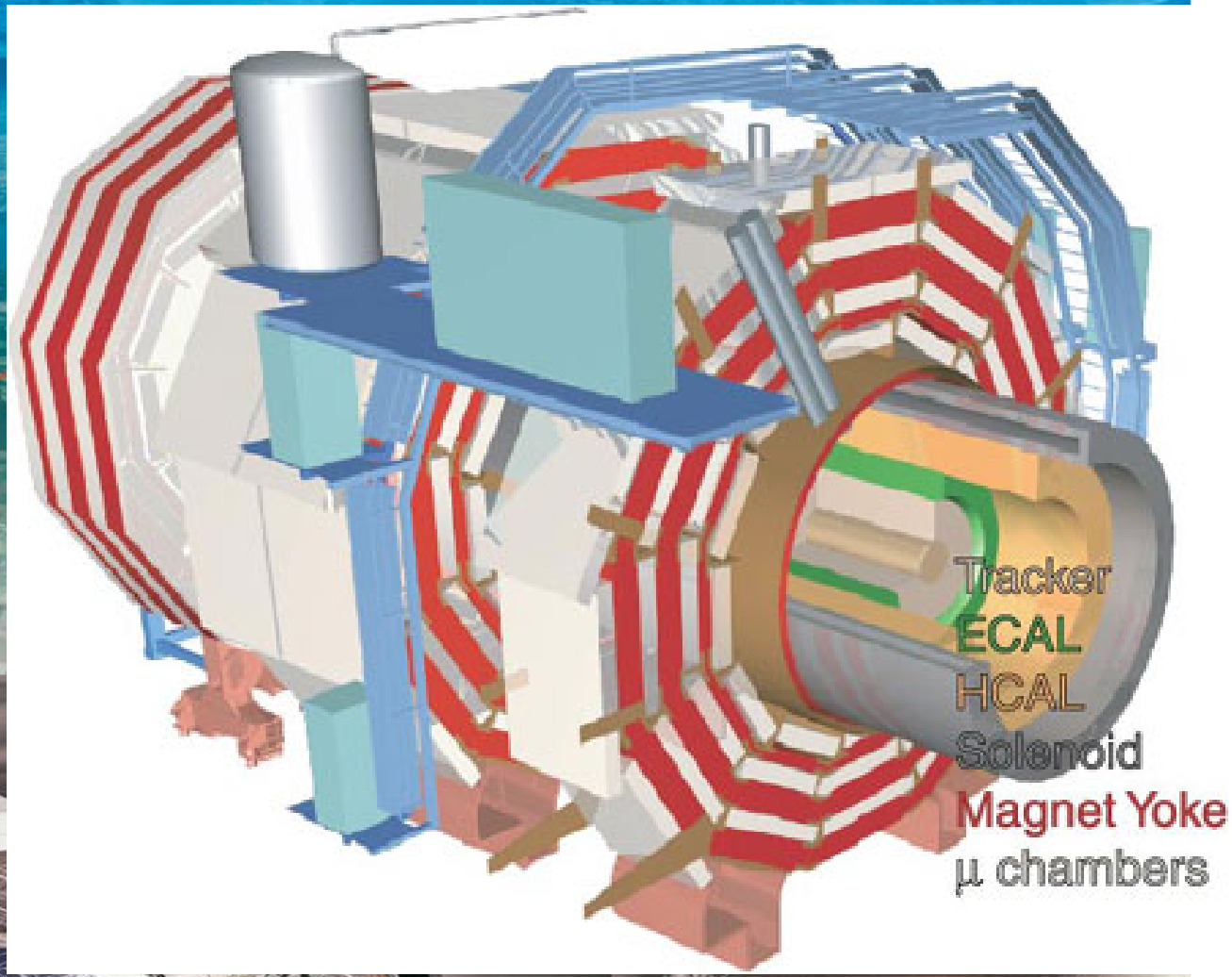
Si-pads

electronic cards

Trigger –DAQ

Magnet

Computing

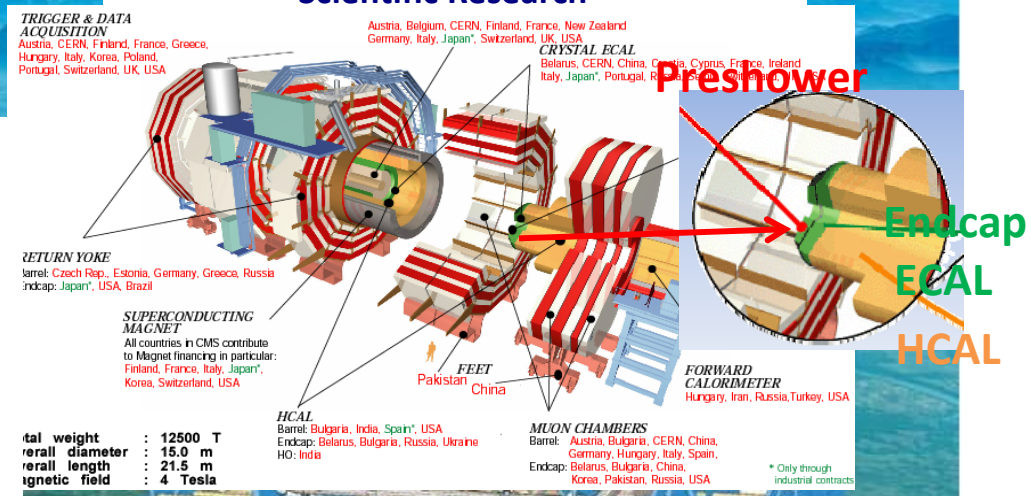


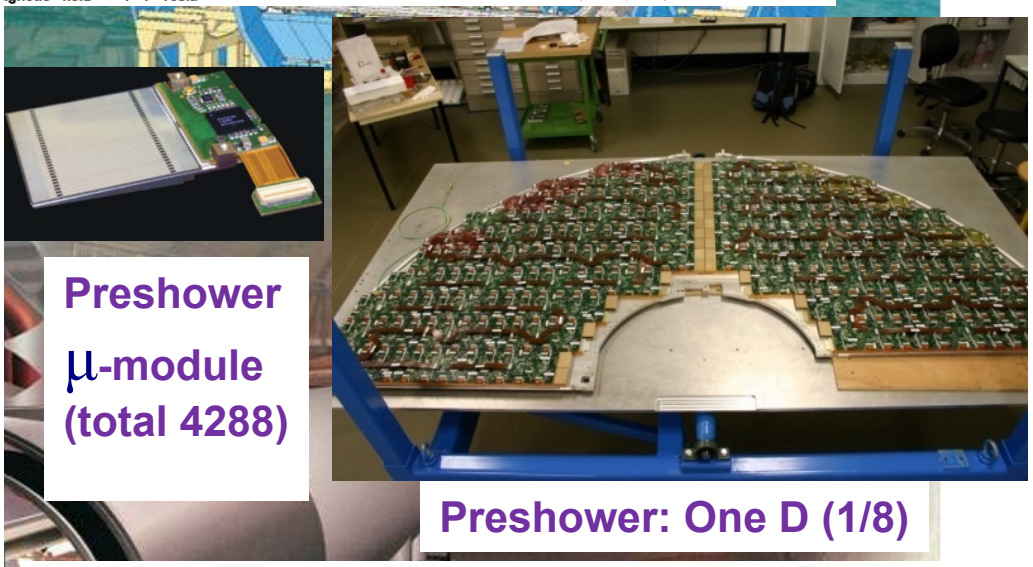
The Greek CMS Project

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

Participation:

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





Preshower

μ-module (total 4288)

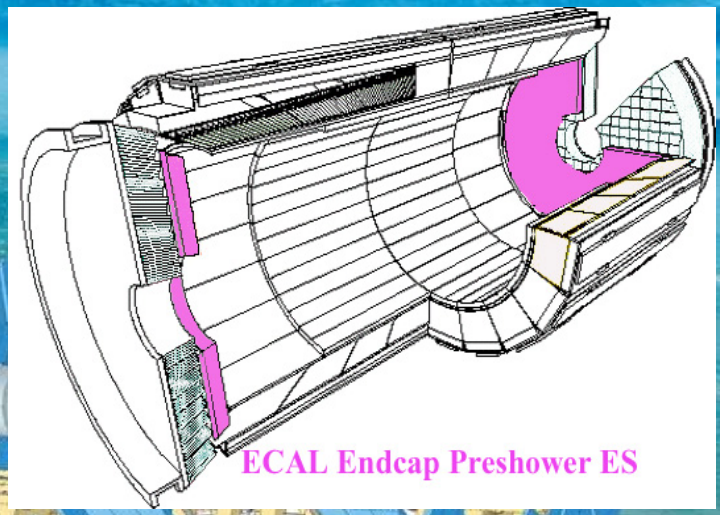
Preshower: One D (1/8)

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

The INSTITUTE of NUCLEAR PHYSICS "DEMOKRITOS" (INPD)

The pre-shower project is a joint effort :

- ***Armenia (Yerevan P.I.)***
- ***Belarus (U. of Minsk)***
- ***CERN***
- ***Greece (NCSR Demokritos, U. of Ioannina)***
- ***India (BARC, U. od Delhi***
- ***Russia (JINR Dubna)***
- ***Taiwan (TU, NCU)***



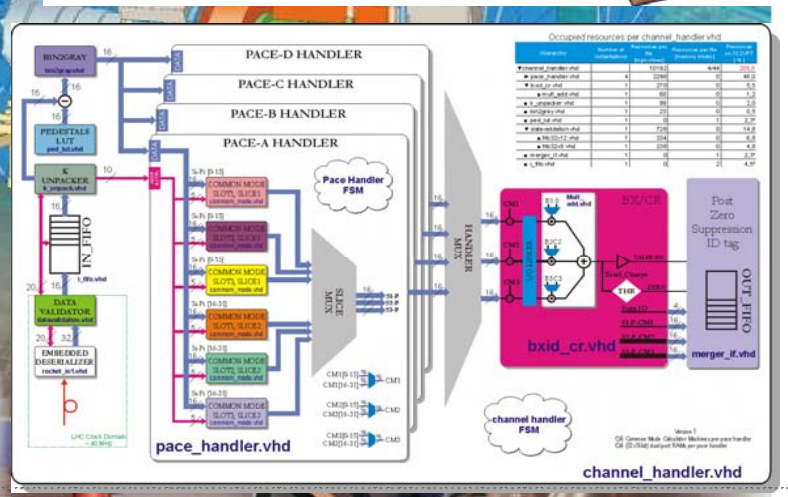
Demokritos is committed to the construction of **500 micromodules** :

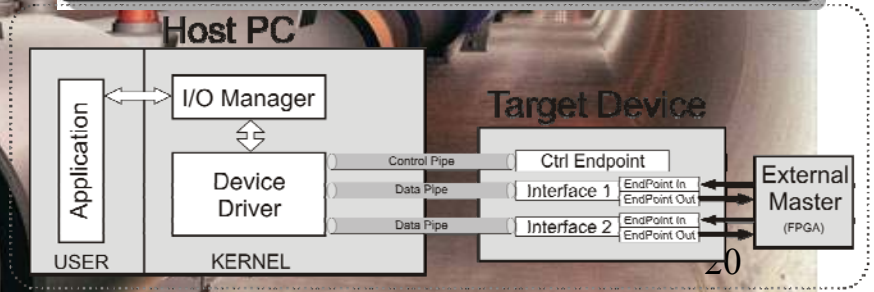
- **516 silicon sensors** are available and already tested :
  - **50** from the Institute of Microelectronics
  - **40** from Russia (ELMA)
  - **426** from Hammamatsu
- Hybrids and Tiles in the way of fabrication
- VLSI electronics finalized

The UNIVERSITY of IOANNINA (UI)

EXPERIENCE & INTERESTS

- High Energy Physics, Nuclear and Elementary particle detectors, medical imaging detectors
- VHDL SOC (System on Chip Design)
  - Algorithm development for HEP data manipulation
- Firmware implementation for high data rate interfaces
- Computer software (Assembly, Fortran, C, C++, Visual C, Visa, Java, html, Matlab): DAQ and control software, computer simulations, data analysis



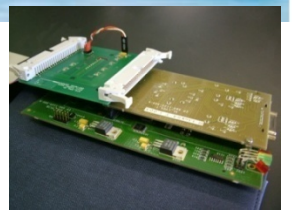


The Greek CMS Project

Participation(continue):

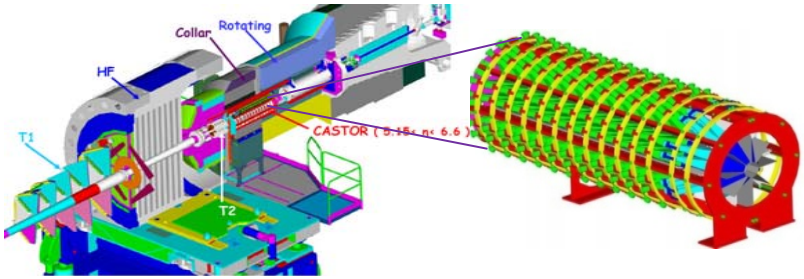
•**Trigger/DAQ** (mainly **DEMOKRITOS**)
- Development (GTPe)
- Construction (IOP, GTPe)
- Evaluation

Input-Output Processor (IOP)



Global Trigger Processor emulator (GTPe)

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

• **Future plans**: Data Analysis, S-LHC.

The Greek ALICE Project

Hardware/Software Contributions of the NCUA 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)

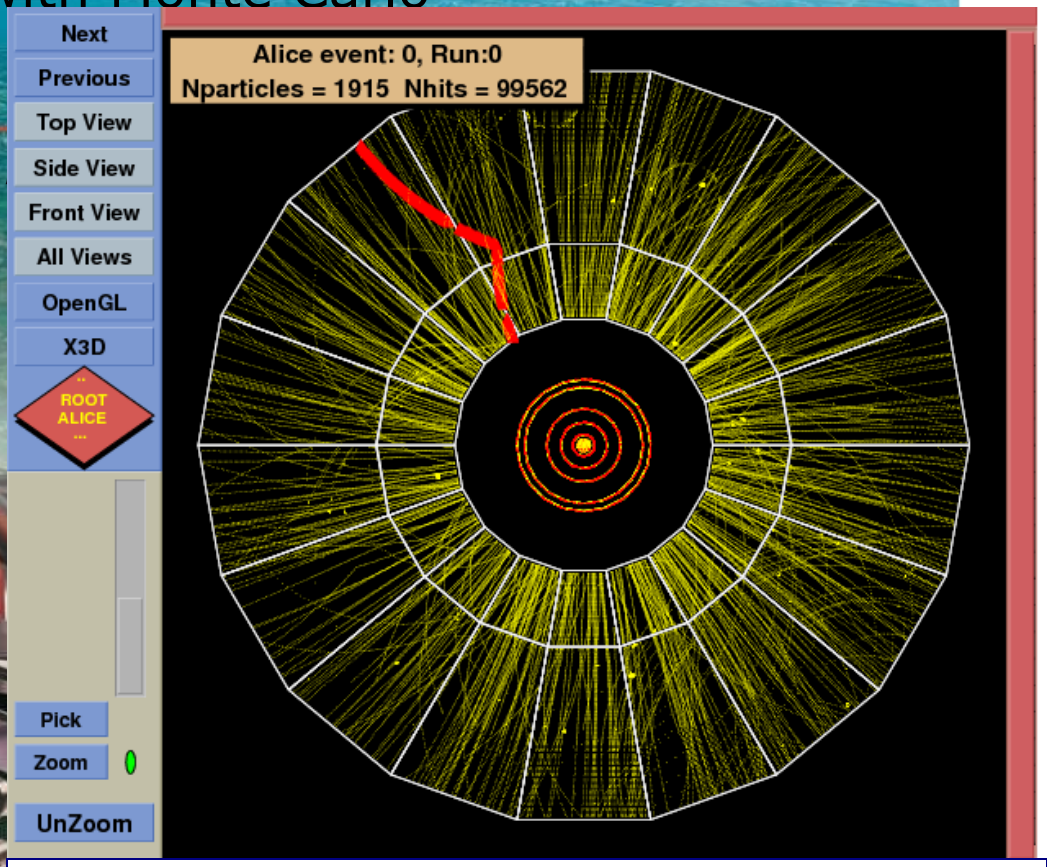
HVDS Description

➔ 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.

Contributions to Physics Analysis Software of the NCUA 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



K/π separation from their decays in the TRD detector

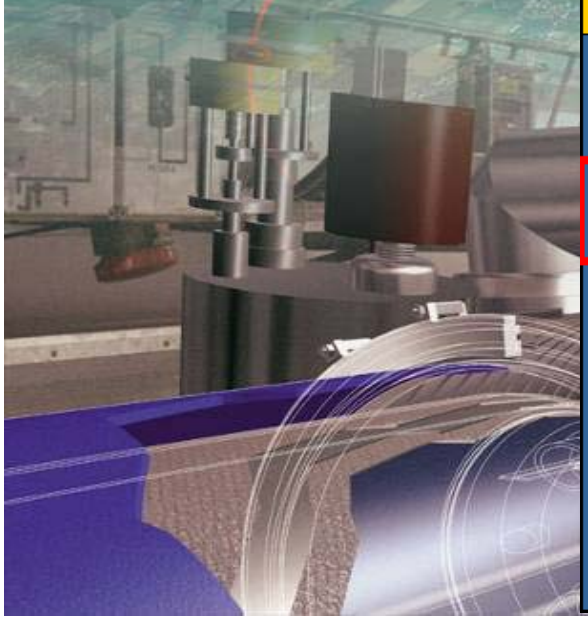
The Greek N-TOF Project

- **Aristotle University of Thessaloniki**
- **NTUA**
- **University of Ioannina**
- **NCRS Demokritos**

❖**Measurements relevant to fundamental physics,**

❖**Nuclear Astrophysics,**

❖**Nuclear fuel cycles and incineration of nuclear waste**

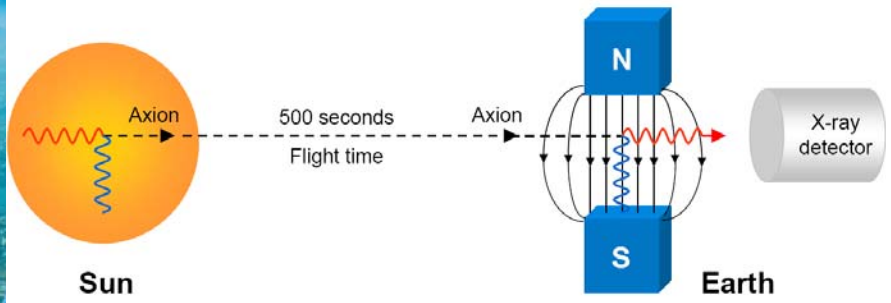


Capture measurements	
Mo, Ru, Pd stable isotopes	r-process residuals calculation isotopic patterns in SiC grains
Fe, Ni, Zn, and Se (stable isotopes) ^{79}Se	s-process nucleosynthesis in massive stars accurate nuclear data needs for structural materials
A≈150 (isotopes varii)	s-process branching points 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

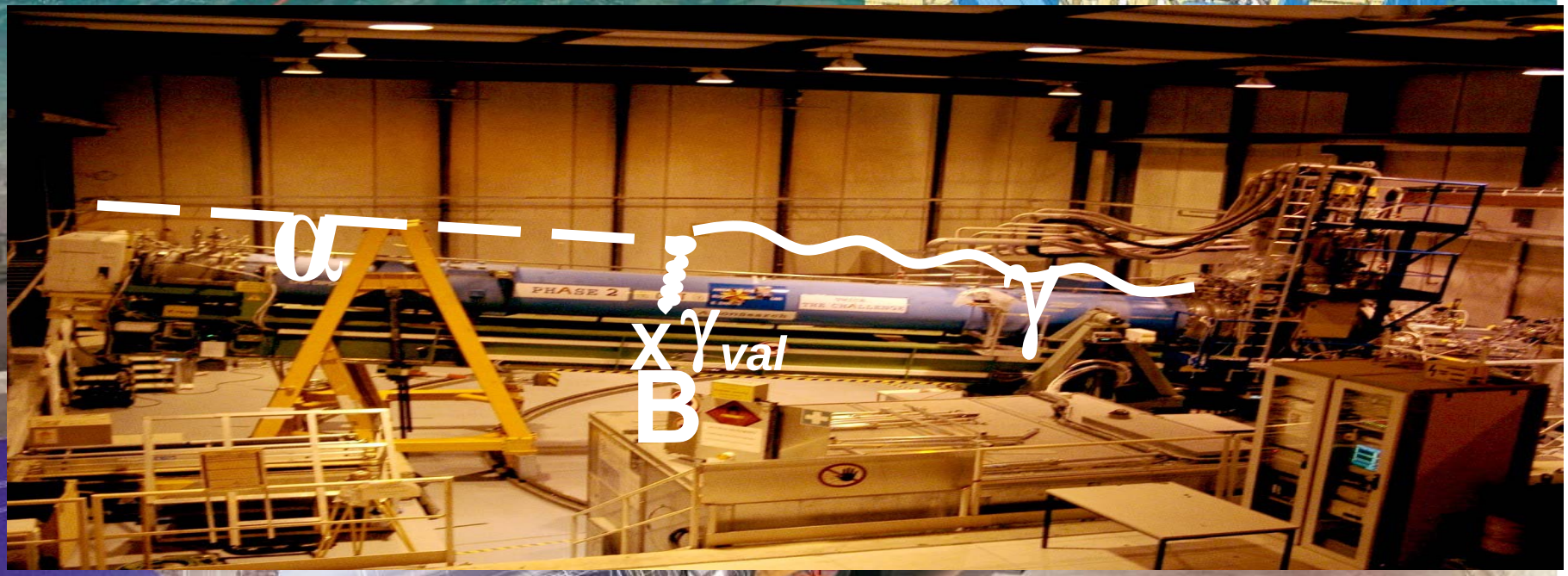
The CAST Experiment

CERN Axion Solar Telescope

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



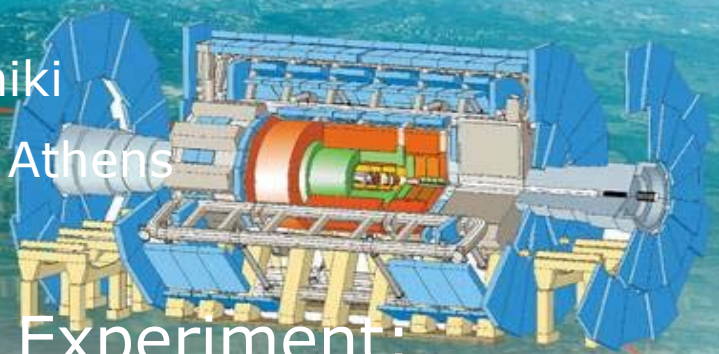
axion source *axion detection*



The CAST Experiment

CERN Axion Solar Telescope

- Participating Institutes:
  - ✓ University of Patras
  - ✓ NRCS 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

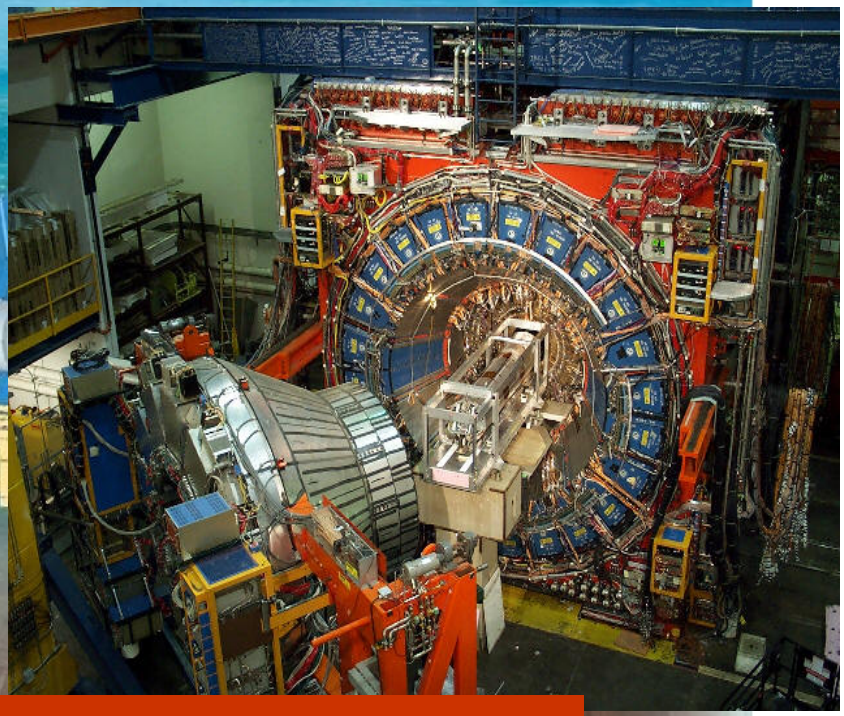
Experiments outside CERN

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



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

- Forward electron P_T spectrum
  - Measured cross-section

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

Physical Review Letters volume 98 issue 25, page 251801.

  - Compared to cross-section from central region

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

  - Theoretical prediction : 2720±130pb

Univ. of Athens neutrino group

Activities:

- DONuT Experiment (Completed)

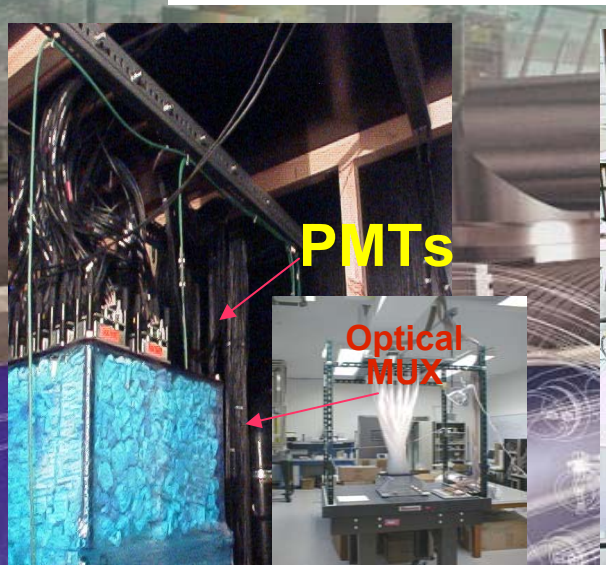
- MINOS Experiment: Far Detector PMT Testing and Characterization; Near detector commissioning; CC Data Analysis.

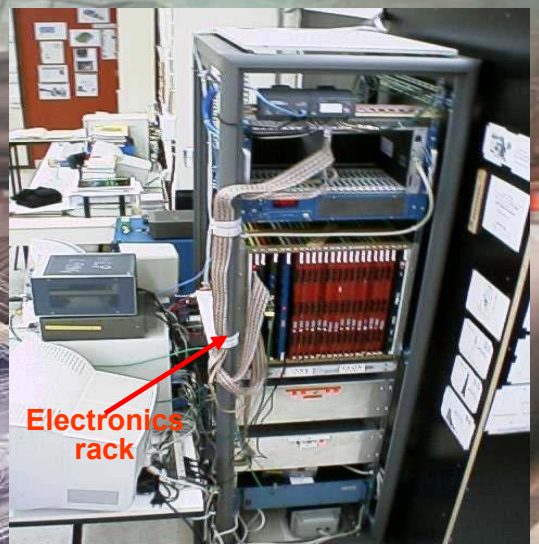
- MINERvA Experiment (In construction phase); PMT Testing and Characterization; Design of the Test stand; Software development

- NOvA Experiment (In construction)

- Construction of a PET prototype

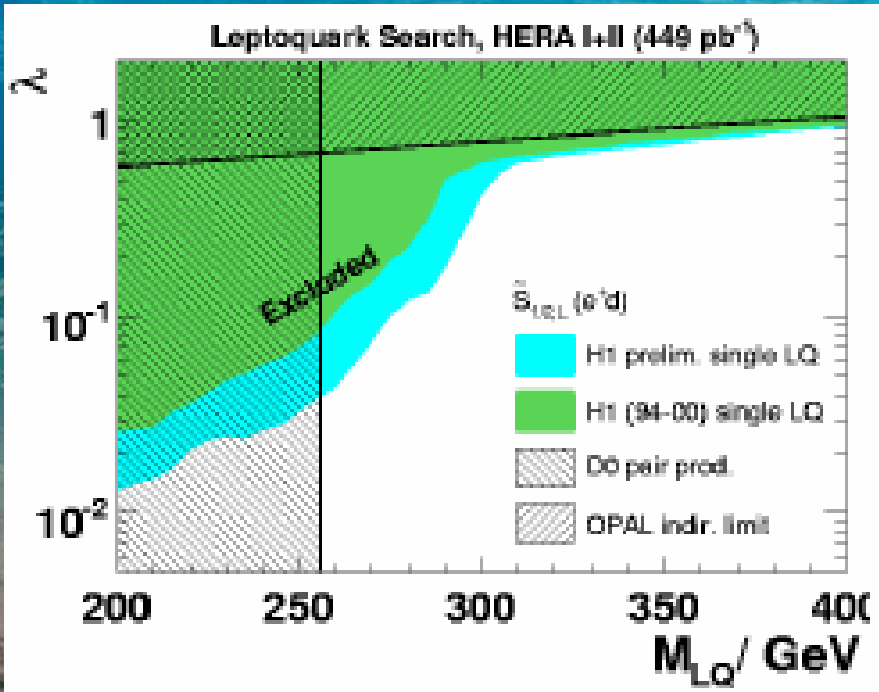
Total number of tested PMTs for MINOS FAR DETECTOR: 750

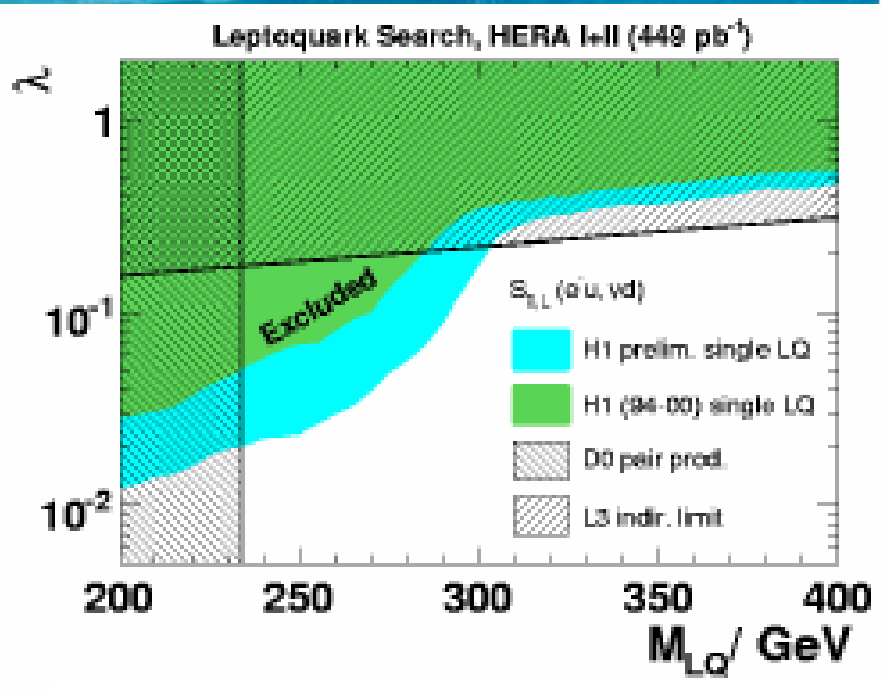




Greece in HERA/H1

NTUA-Exotics





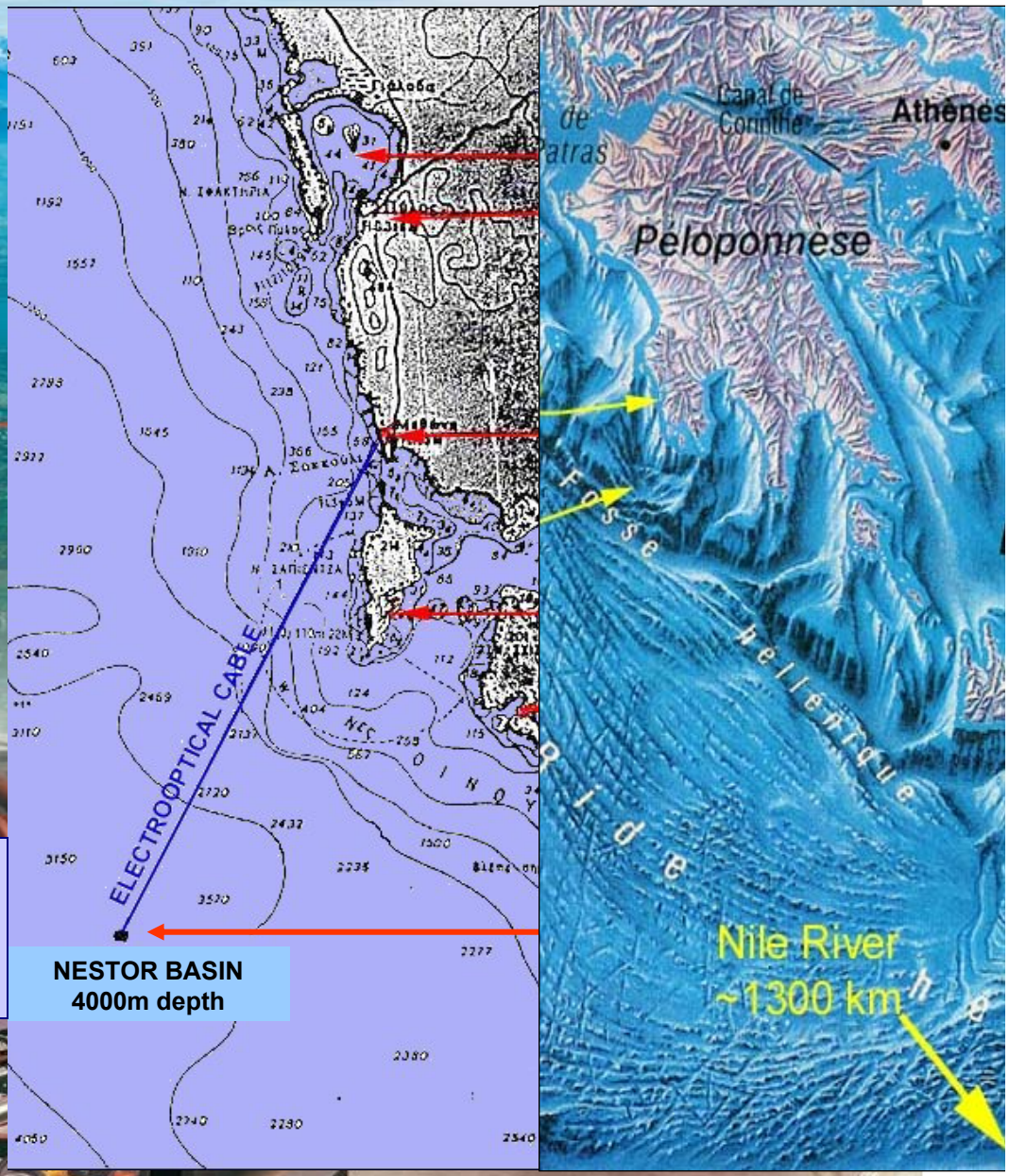
LQ Exclusion Limits – Comparison with LEP & Tevatron

HERA extends the exclusion region

Experiments outside CERN

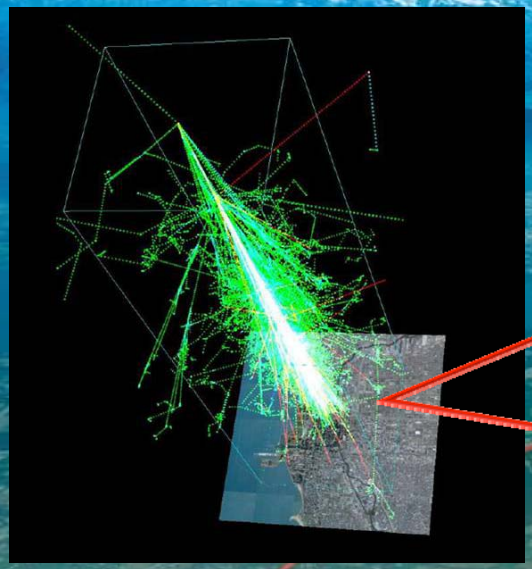
The Nestor Project in Greece

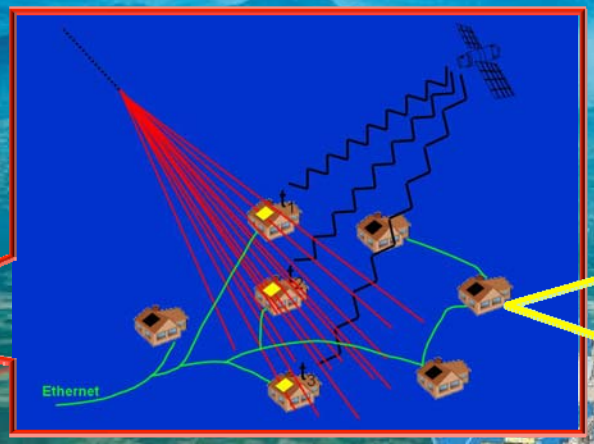
Electro-optical cable
Length: 30km,
18 optical fibres,
conductor (6kW)

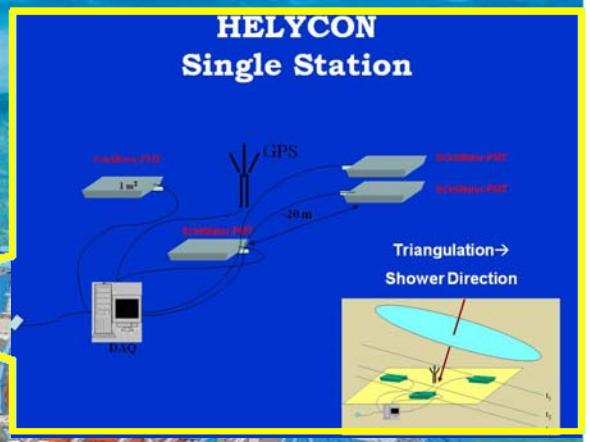


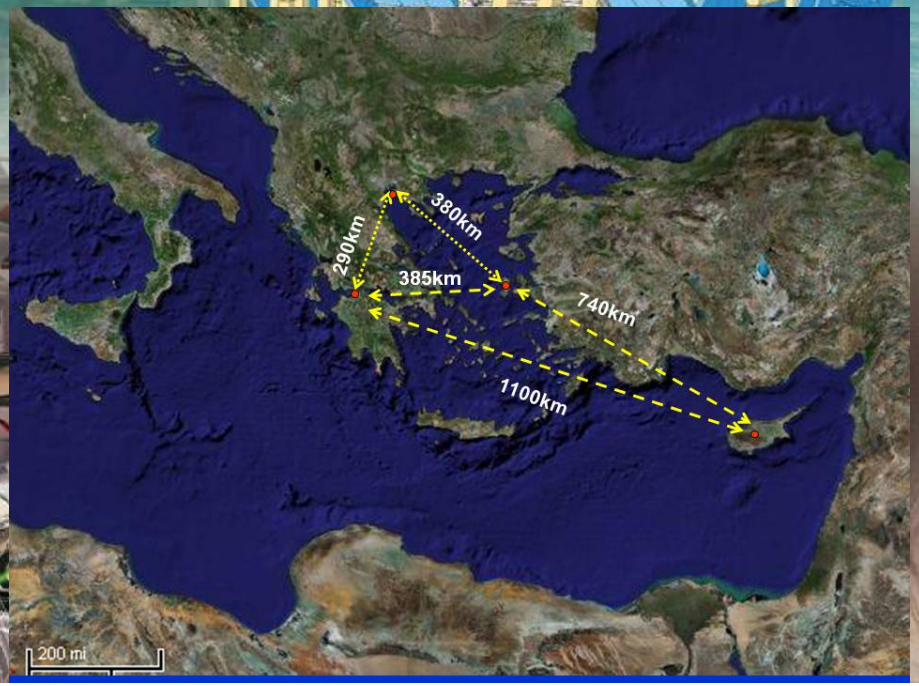
HELYCON

Hellenic Lyceum Cosmic Observatories Network









Future Experiments @ CERN

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

Greece @ LHC CRYOGENICS : (NTU-Athens, TEI-Ath, TEI-Peiraus) for 2006-2008

Collaboration agreement K1257/AT/LHC (2/2006-9/2008)

Accelerator Department in Cryogenics Instrumentation and Controls

CERN Responsible: Dr. P. Gomes - Dr. R. Saban – Dr. E. Tsesmelis

Greek Scientific Responsible: EG (NTU_A)

1 Physicist (PhD-team leader), 1 Computer Scientist, 3 Computer Engineers, 7 Electronics Engineers

The most important of the tasks

1. Development and maintenance of two test benches for the validation of LHC Cryogenic Electronics (10,000 electronic cards+800 crates) for manufacturing company and CERN
2. Testing and troubleshooting of more than 12,000 cryogenics sensors and actuators, 800 crates, cards and cables with three Mobile Test Benches in the LHC tunnel (shift work when necessary)
3. Design and maintenance of supervision panels (PVSS+CIET)
4. Development of software tools for fast and efficient panel development, replication and maintenance (PVSS+CIET)
5. High Voltage Qualification Tests on the electrical lines related with the readout of the temperature sensors installed on the DFB current leads
6. Electronics maintenance and repair
7. Testing of Liquid He Level Sensors
8. Full documentation of the work
9. Presentations in international conferences and publications

Computing

HELLAS GRID Task Force

Purpose : 1. national strategy for GRID technologies development

2. connected to EGEE, EGO projects

3. for LHC-HEP analysis, the LCG-MoU not yet signed

4. Greece the center for the South East Europe Federation for GRID/EGEE

GRNET Organisation (for networking the universities and academia)

GRID nodes : Crete, Patras, Athens (IASA), Athens (Demokritos), Thessaloniki

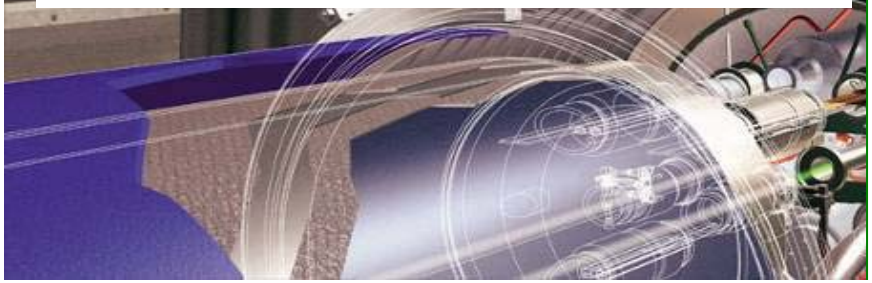
In total : ~ 1000 CPU'S, ~ 100 TB HD storage & tapes (limited threshold for TIER-2)

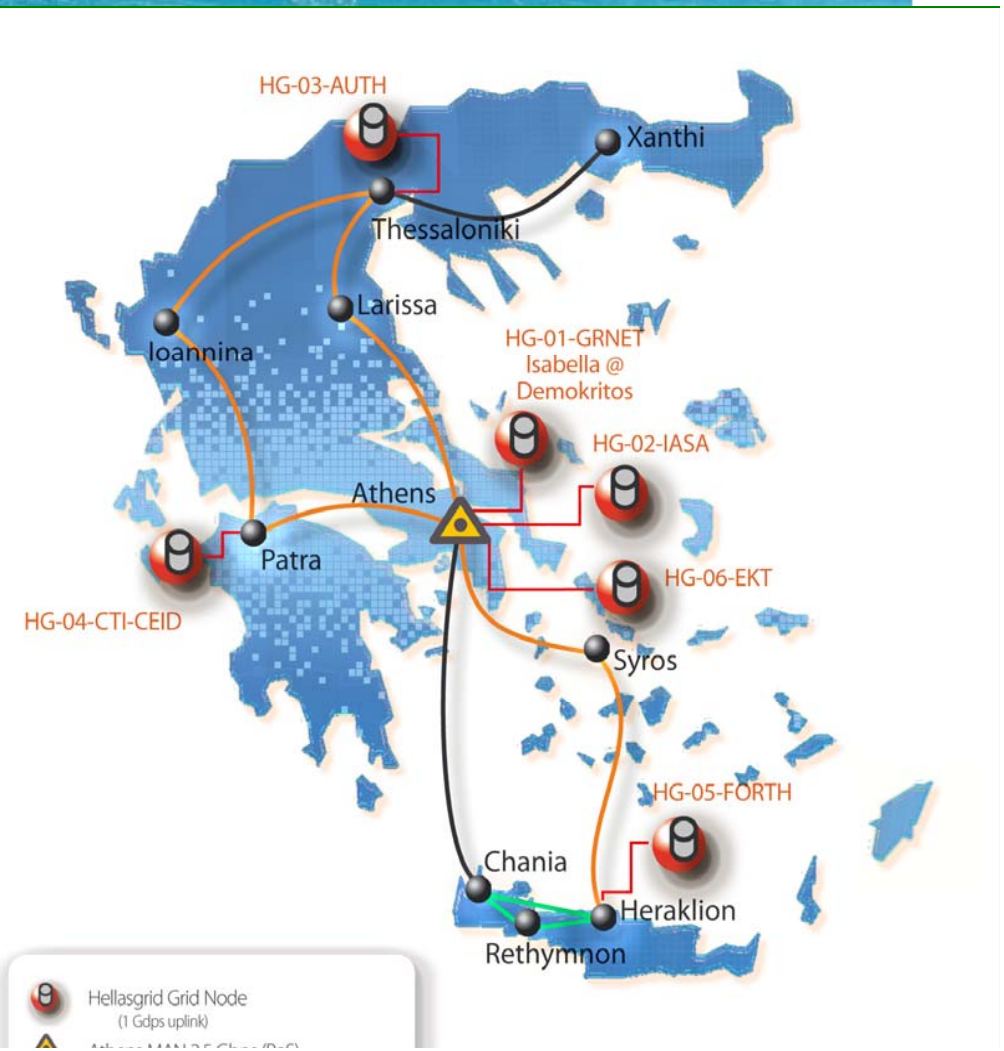
… BUT GRNET is NOT only for HEP !! ➔

➔➔➔ Large amount of infrastructure is still needed for TIER-2 !!

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





Greek Committee for the Cooperation with CERN

The Greek Committee for the Cooperation with CERN

is consisted of 14 members from ALL the Greek institutions participating to the CERN experiments

AUTH, NCUA, NTUA, UoI, UoP, DEMOKRITOS

In addition : International Committee

5 Members of distinguished Greek Scientists working in the abroad (CERN, France, USA)

Greek Committee for the Cooperation with CERN

D. Nanopoulos	President	CERN Delegate
A. Lahanas	Vice-President	
E. Gazis	General Secretary/Financial Affairs	CERN Deputy Delegate
E. Dris, Ch. Petridou A. Markou, F. Triantis M. Stassinaki-Spyropoulou K. Zioutas, S. Tzamarias	ATLAS CMS ALICE CAST, HELLYCON	
K. Tamvakis Ioan. Bakas G. Gounaris	Theory Theory Theory	
C. Papadopoulos	Greek HEP Society	
N. Samios, V. Polychronakos Ign. Antoniadis Ioan. Giomataris Ioan. Karyotakis	BNL CERN/Ecole Polytech. SACLAY LAPP-ANNECY	

Funding @ CERN

YEAR	Greek Contribution	% CERN	LHC Experiments CF, M&O, etc	LHC Participa -tion	ILO + Others	TOTAL (CHF
2002	10,303,000.0	1.075	394,945.0			10,697,945.0
2003	11,446,650.0		340,396.0			11,787.046.0
2004	12,612,100.0				15,000	12,627,100.0
2005	13,799,800.0	1.39	413,106.0	641,600.0	10,000	14,864,506.0
2006	14,299,800.0	1.43	3,256,650.0		15,000	17,571,450.0
2007	15,854,400.0	1.54	5,890,000.0			21,744,400.0
2008	19,665,600.0	1.83	3,460,000.0	94,400.0	29,600	23,249,600.0
	97,981,350.0		**13,755,097.0**	**736,000.0**	**69,600.0**	**112,542,047.(**

Funding for Soft Activites

YEAR	Ministry of Education	Ministry of Development LHC Participation	TOTAL (EUROs)
2003			
2004			
2005	1,200,000.0	401,000.0	
2006			
2007			
2008		59,000	
	1,200,000.0	**460,000.0**	**1, 660,000.0**

Technology Transfer / CERN orders

Industrial Liaison Office : established on 1994

~ Every 2 years meeting at Greece with CERN officers, greek scientists and industry

Database of industry : ~ 100 firms

Return Index : - Supplies

- Services

- Visiting teams commitments

Technology Transfer / CERN orders

Industrial Relay Center : Greek branch

A Full Database of Greek industries

Provides information to the CERN Purchase Office.

Technology Transfer -Network : CERN Council decision
(**NTU-A coordination for Greece**)

Still many thinks to be fixed (TT-Offices at the Greek Universities,

Startup procedure, etc.)

NEWS / FUTURE PLANS I

1. New **Frame-law** for research in Greece 2007 (re-organization of structure, new institutions, etc.)

Important Points of special **support**:

Basic Research

Research to International Organizations

2. **National Institution** for research coordination on

- Nuclear Physics
- Particle & Astroparticle Physics
- Cosmology
- Non-Accelerator Physics

3. New **long-term budget planning** for CERN experiments under discussion

NEWS / FUTURE PLANS II

- BEST participation on the **LHC + other experiments**
- Extension to the **GRID** projects (EGO, etc)
- New CERN-GREEK agreement for partial support of Greek students (summer, technical, doctoral, fellows). (**MoU in preparation**)
- Start-up participation to the advanced accelerator technology (**CLIC, ILC, Proton Therapy , etc.**) (**MoU in preparation**)
- Start-up participation to industrialization of technological patents (**CERN-Technology Transfer**) (**MoU in preparation**)

EPILOGUE

The Greek Committee for the Cooperation with CERN:

1. Takes ALL the necessary action items to help the research teams to participate essentially the very exciting times ahead of us during the LHC operation!!

2. Supports projects for SLHC, CLIC and Spin-Off applications

We hope that many

YOUNG PHYSICISTS and ENGINEERS

will join us in this discovery enterprise