

Greek Institutes Projects at CERN

Past, present and future

*Theodoros Geralis,
Director of Research
Institute of Nuclear and
Particle Physics*

- **Greek groups participation at CERN**
- **Recent experimental activities**
- **Future Plans - Upgrades**

CERN – Greece *Industry day*
31 March 2014

Research Institutes and personnel in Particle and Astroparticle Physics in Greece

Research personnel in Particle and Astroparticle Physics in Greece				
University/Institute	Activity	Researchers	PhDs	Total
Univ. of Thessaloniki	ATLAS-LHC, CAST	7	6	13
Hellenic Open University	ATLAS-LHC, KM3	7	1	8
University of Athens	CMS-LHC, ATLAS-LHC, ALICE-LHC, KM3	19	10	29
National Technical University of Athens	ATLAS-LHC, CAST, ASTRO	9	6	15
INPP, NCSR Demokritos	CMS-LHC, CAST , KM3, pEDM	14	4	18
University of the Aegean	ATLAS, KM3	2	1	3
University of Ioannina	CMS-LHC	7	1	8
University of Patras	CAST, pEDM	1	2	3
Total Experimentalists		63	31	94
University of Thessaloniki	HEP Phenomenology, Cosmology	3	1	4
IINPP, NCSR Demokritos	Beyond SM, Cosmology, HEP Phenomenology	4	4	8
University of Athens	Beyond SM, Cosmology	10	7	17
National Technical University of Athens	Beyond SM, Cosmology	7	9	16
University of Ioannina	Beyond SM, Cosmology	12	4	16
University of Crete	Beyond SM, Cosmology	10		10
University of Patras	Beyond SM, Cosmology	8	5	13
Total Theorists		54	30	84
Total		117	61	178

Activities at CERN

Participation in the experiments

ATLAS	(Univ. of Athens, NTUA, Univ. of Thessaloniki)
CMS	(Univ. of Athens, Demokritos, Univ. of Athens)
ALICE	(Univ. of Athens)
CAST	(Demokritos, Univ. of Athens, NTUA, Univ. of Patras)
n-TOF	(Demokritos, Univ. of Thessaloniki, NTUA, Univ. of Ioannina)

Participation in RDs

RD50	Si Detectors development (Demokritos)
RD51	Micro Pattern Gaseous Detectors development (Univ. of Athens, NTUA, Univ. of Thessaloniki, Demokritos)

Participation in the LHC commissioning

LHC Cryogenics: (AUTH, NTUA, TEI-Athens, TEI-Piraeus)
12 Engineers 2006-2008
~15 in 2013 – 2014 service

Greek Institutes Contribution to the LHC experiment overview

ATLAS

- 1) **Construction of 128 MDT-BIS chambers (30000 drift tubes)**
- 2) **Detector Control System**
- 3) **Tile calorimeter: 30000 PMT testing**

CMS

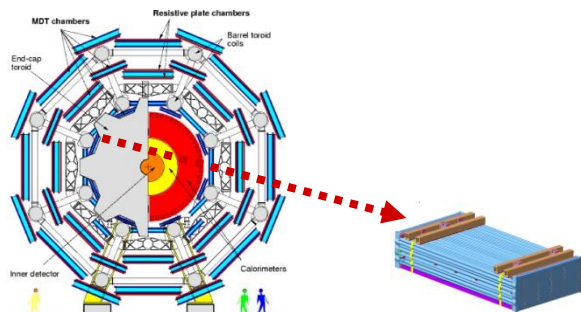
- 1) **Construction of 25% (1200 micromodules) of the Preshower and Design and manufacturing of the Preshower electronics**
- 2) **Trigger and DAQ design and construction, HLT systems and clusters**
- 3) **CASTOR detector construction**

ALICE

HV Electronics, Detector Control system, and Data acquisition



The “Greek” muon chambers concordium of ATLAS (MDT-BIS)



The Greek ATLAS collaboration
(Construction in Greece : 1999-2004)

NCUA : MDT construction (30 000)

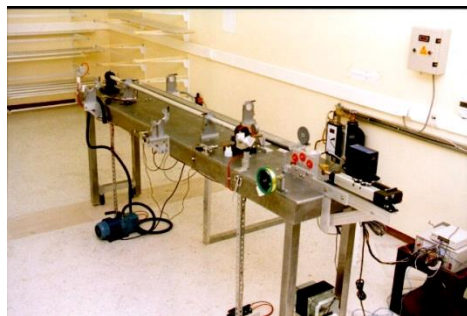
NTUA : QA_QC (30 000)

AUTH : Grouping in 112 chambers

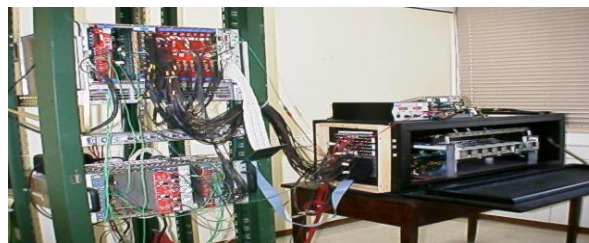
Athens: Construction →

NTUA: QA – QC →

Thessaloniki: Chamber Assembly



ATLAS Tile calorimeter
Quality control of 10000 PMT tubes



Univ. of Athens

ECAL: The CMS Preshower detector design and construction

NCSR Demokritos, Univ. of Ioannina

Silicon Detectors design & fabrication

1200 micromodules (among 4800) assembled in Demokritos and Univ. of Ioannina

- **Close collaboration with the Greek Industry**
4500 Hybrid electronic modules built by PRISMA SA Gold Industrial Award



GOLD AWARD to

**PRISMA ELECTRONICS S.A.,
Alexandroupolis (Greece)**

The front-end hybrid PCB for the CMS Preshower was a very challenging project. In addition to producing the PCB itself, the mounting of the components (particularly a 196-pin BGA package) whilst keeping the delicate gold bond pads clean etc. involved some lengthy manual operations. Prisma were selected to assemble and test these pieces, a task that they carried out with patience and diligence. Of particular note was their flexibility: the initial difficulties with producing a suitable PCB meant that their part of the project took two years longer than originally foreseen. During this long period they collaborated with us closely and were always willing to put our project ahead of others in their queue, due to our strict time constraints. The end-product speaks for itself: the number of accepted pieces, that passed all our specifications, was very close to 100%.

Proposed by Philippe Bloch/Dave Barney

6/2/2014

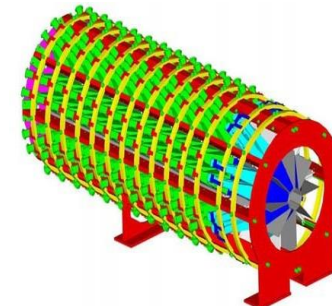
T. Geralis

3

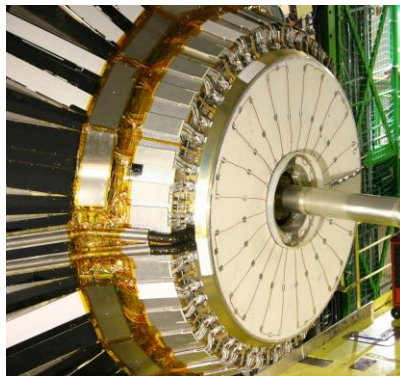
The CMS Trigger and DAQ: 10 GTPe's built at NCSR Demokritos



The CMS Castor Detector: Univ. Of Athens



Preshower installation

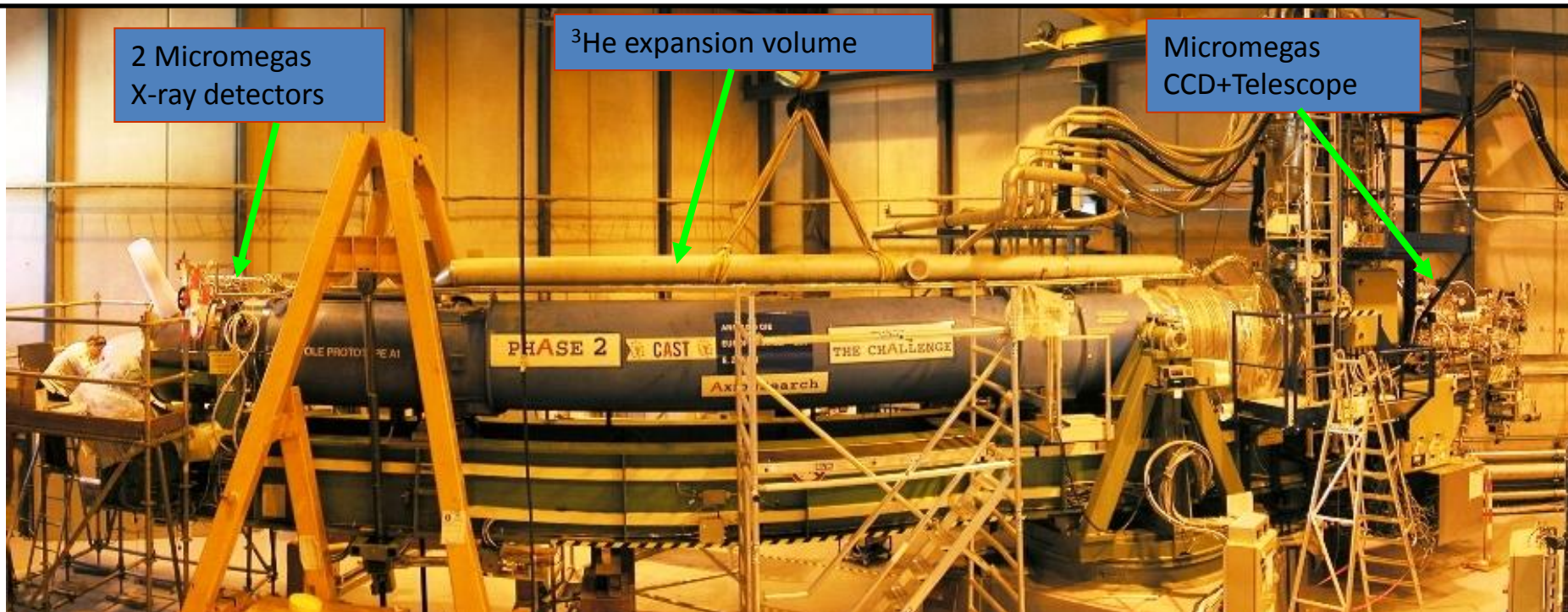


The CAST Experiment

National Center for Scientific Research Demokritos –NTUA Athens –
University of Patras -- University of Thessaloniki

THE GREEK CONTRIBUTION

- **Strong Greek contribution** in the proposal and the creation of the Collaboration (Proposal, **Spokesman Prof. K. Zioutas** - Univ. of Patras)
- **Important contributions:** 1) Micromegas detectors (INP), 2) DAQ systems (INP), 3) MC simulations (INP), 4) Development of the He-3 system, 5) Novel Analysis Techniques (INP) and 6) Running the experiment
- **Rotating platform constructed by Greek Company (PYLON)**

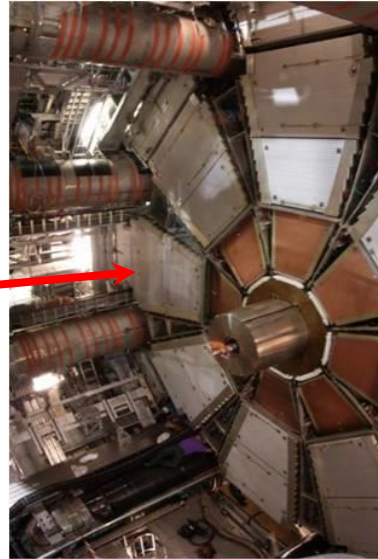
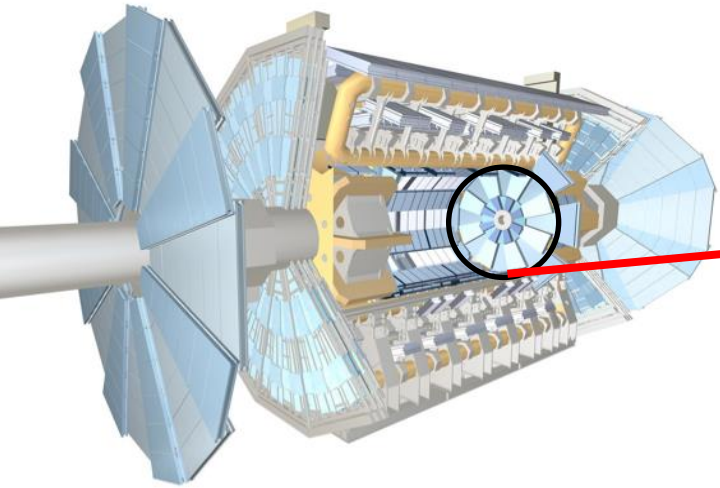


ATLAS Upgrade Plans (Phase I, 2018)

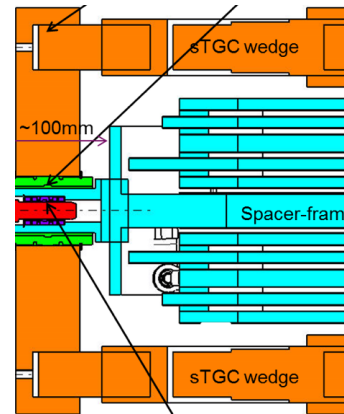
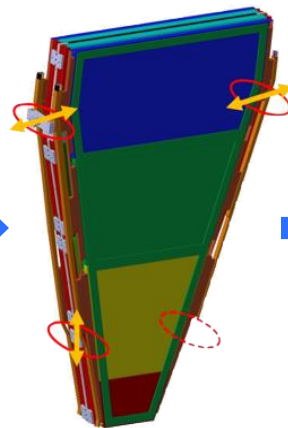
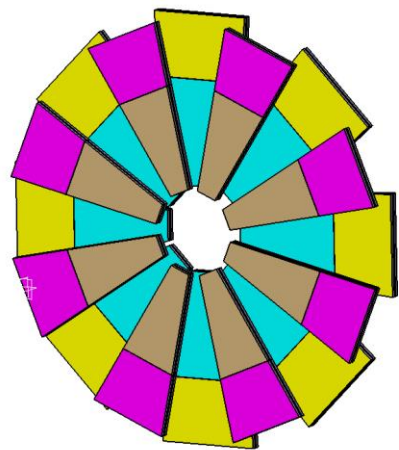
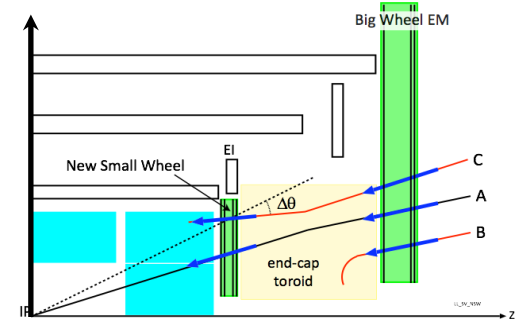
1) The New Small Wheel (Micromegas chambers)

2) Triggering (Associative memories)

The ATLAS New Small Wheel Upgrade 2017-18 (Phase I)



The innermost station of the muon endcap
Located between endcap calo and toroid

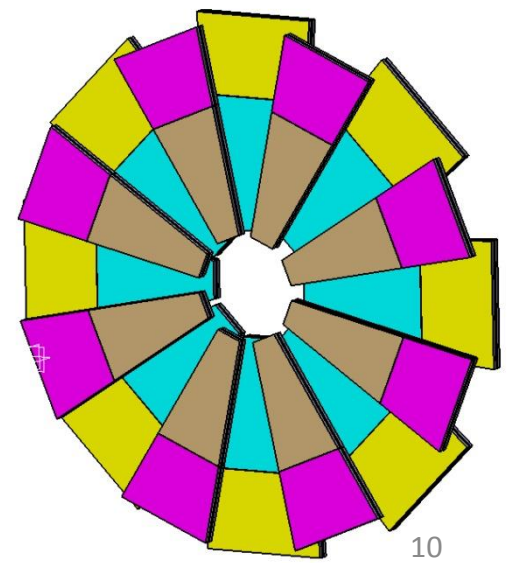
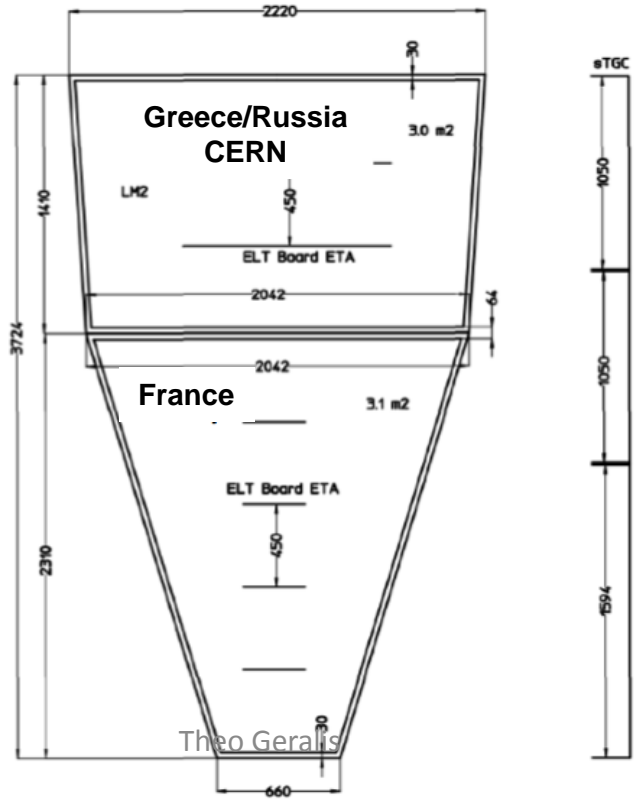
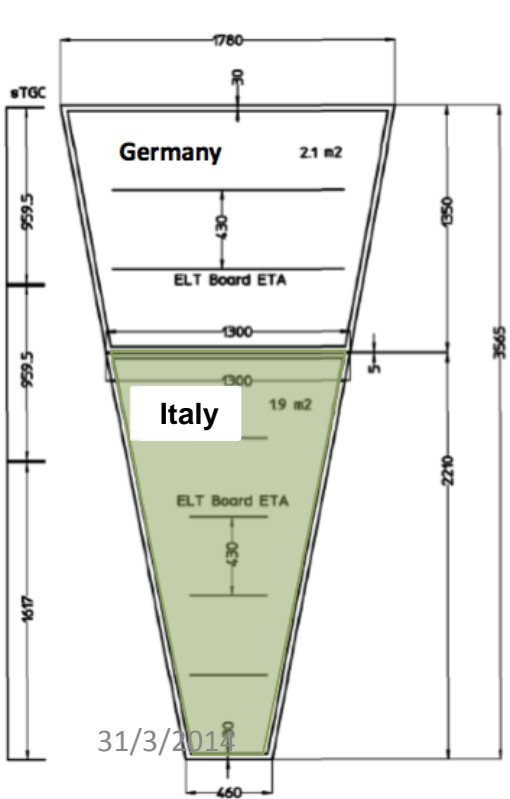


**Two technologies:
Micromegas & sTGC
will provide tracking
and trigger data**

Micromegas Construction

- Mechanics & Electronics** is a multi-national operation; Mechanics: institutes from 6 countries, Electronics: Institutes from 10 countries (USA, Italy, Romania, Netherlands, Italy, Israel, Greece, France, Chile, Taiwan) -- Total: 30 Institutions are involved
- 8 layers of Micromegas detectors will equip each large & small NSW sectors; for half of the layers, the strips will be under a stereo angle to measure the second coordinate.

Total Surface	1200 m ²
Total number of MM Channels	2.1 M
Micromegas Strip Pitch	0.445 mm
Gas	Ar:CO ₂ 93:7 atm pressure
Drift Gap	5 mm
Amplification Gap	128 μm
HV on Resistive Strips	550 V
Drift Field	600 V/cm
Resistive Strips	10-20 MΩhm/cm
Stereo Strips on 4/8 Layers	1.5°



31/3/2014

Theo Gerasis

Full Micromegas Development Time-Plan

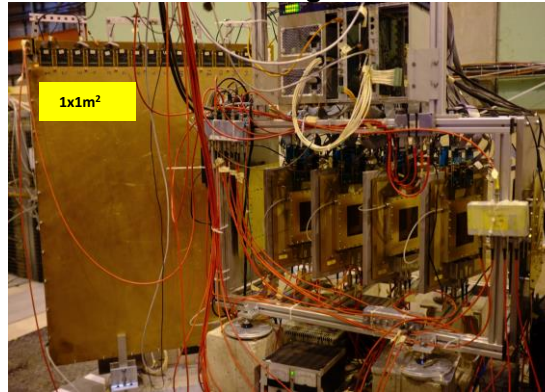
non-resistive MM, SPS/CERN,
Demokritos-GR



2008

2009

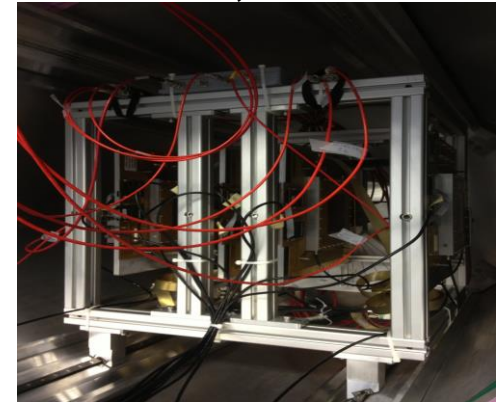
resistive MM, SPS/CERN, Demokritos-GR,
Garching-GE



2010

2011

resistive MM, DESY II/DESY,
LNF-IT, CEA-FR



2012

2013

developed new MM
technology



approved by ATLAS

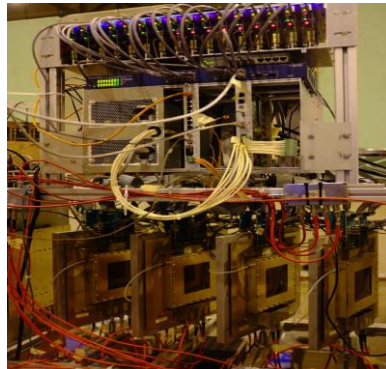


module-0 production
& qualification



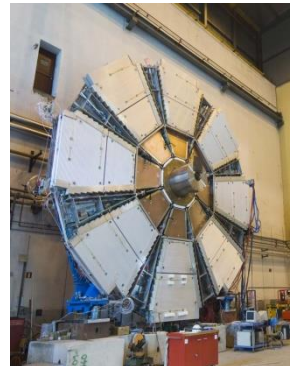
31/3/2014
2014

Full-production of
chambers and electronics



2015

Full commissioning
on surface



2016

Theo Geralis

2017

Full installation in cavern



2018

2019

Running...

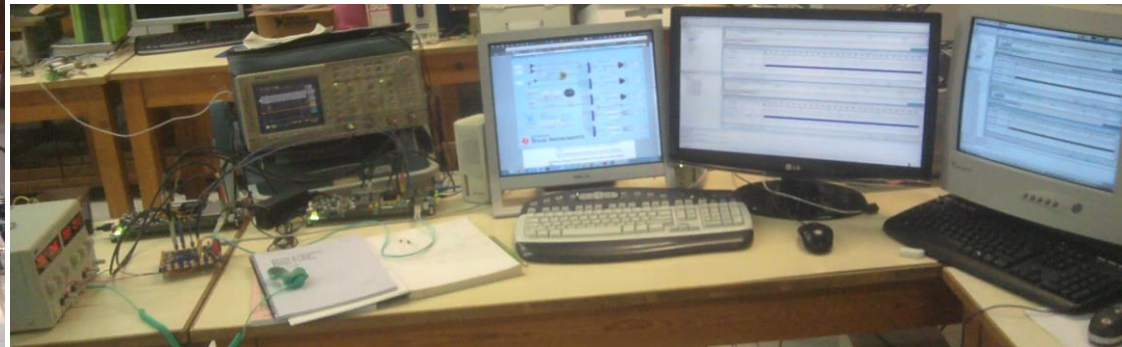
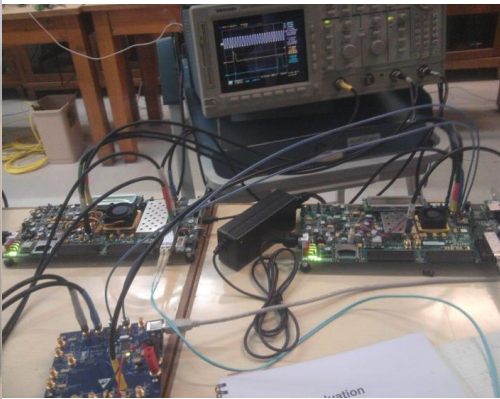
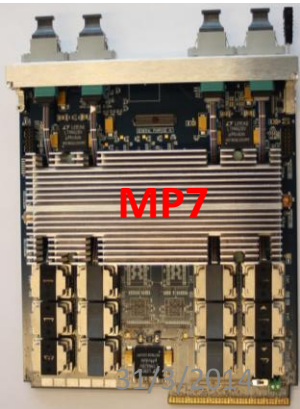
11

CMS Upgrade Plans

- 1) The DTF trigger Upgrade –
uTCA telecommunication standard**
- 2) R&D for Si sensors for the sLHC – Phase II
(Pixel detector upgrade)**
- 3) Micromegas R&D for HCAL at sLHC
Phase II (2022)**

Trigger Upgrades: Ioannina + Univ. of Athens

- UoI along with IASA/UoA are active participants in the DTF upgrade.
 - uTCA DTF is a 2 uTCA crate system which houses 12 MP7 processors
 - We are responsible for the DTF input and output optical link interface.
 - We are responsible for developing an optical 'data generator' for testing the uTCA DTF
- The CMS trigger upgrade schedule foresees:
 - Commissioning of DFFT at P5 during 2015
 - DTF ready for data taking in Q1 2016



Commitment to DTF

13

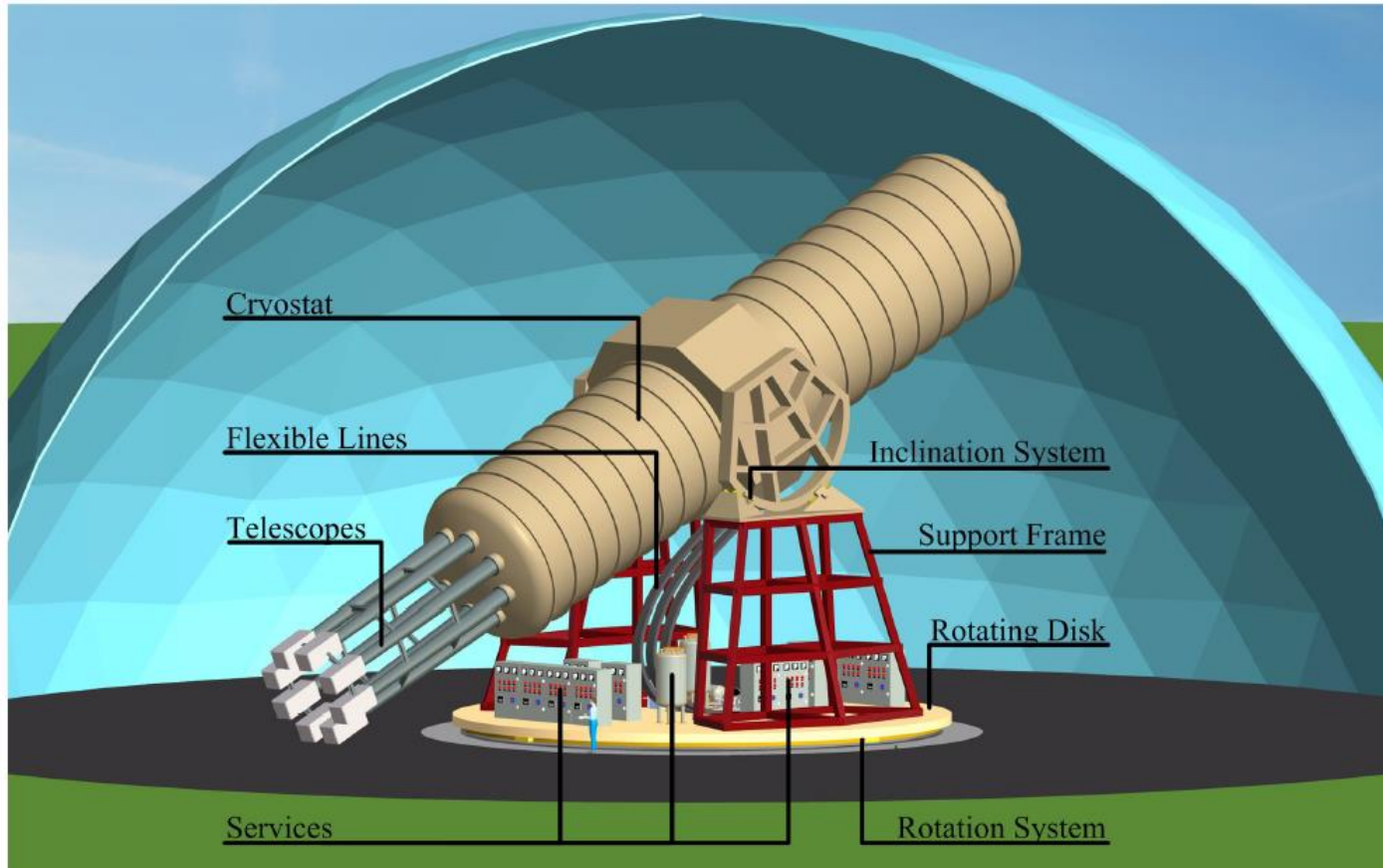
The uTCA Standard for Triggering



- A standard trigger platform is under development based on the uTCA telecom Standard.
- This platform is designed to accept data from different detectors to support a Lv1 tracking trigger.
- This platform will replace all Lv1 trigger off detector electronics and is becoming a CMS-wide standard.
- This would reduce significantly manpower and R&D costs

IAXO: International AXion Observatory LoI, CAST successor.

Univ. of Patras, Univ. of Thessaloniki, NCSR Demokritos



CONCLUSIONS

- 1) Significant contribution of the Greek groups in the construction of the CERN experiments at the LHC (ATLAS, CMS and ALICE) but also in smaller scale projects like CAST**
- 2) On the occasion of the LHC Upgrade (High Luminosity LHC) there is leading participation in the LHC experiments Upgrade (ATLAS and CMS) in Phase I and Phase II**
- 3) Participation in smaller scale experiments is also considered for example in IAXO.**
- 4) The involvement concerns projects on Detector Development and production, on Readout Electronics production, High speed Data Acquisition and Triggering Systems and on computing**
- 5) There are opportunities for construction from the private sector and more particularly from the Greek industries, mainly on Electronics and on mechanical constructions. Industrialization of the detector production is also desirable.**