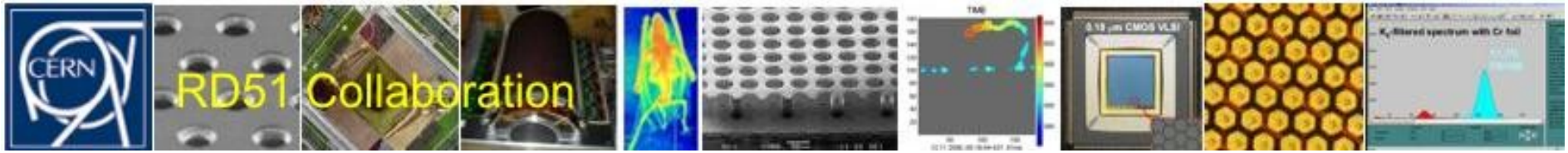


The RD51 Collaboration, Development of Micro-Pattern Gas Detector Technologies

Leszek Ropelewski, CERN, Switzerland
Maxim Titov, CEA Saclay, France

OUTLINE:

- RD51 Motivation and Main Objectives
- RD51 Collaboration Activities and Results
- Summary and Outlook

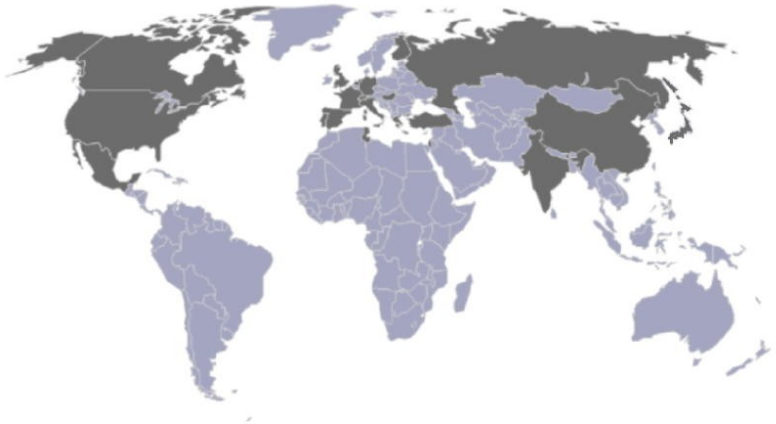
105th LHCC Meeting, CERN, 23-24 March 2011

RD51 Collaboration: Motivation and Main Objectives

World-wide coordination of the research in the field to advance technological development of Micropattern Gas Detectors

- Foster collaboration between different R&D groups; optimize communication and sharing of knowledge/experience/results concerning MPGD technology within and beyond the particle physics community
- Investigate world-wide needs of different scientific communities in the MPGD technology
- Optimize R&D financing by creation of common projects (e.g. technology and electronics development) and common infrastructure (e.g. test beam and radiation hardness facilities, detectors and electronics production facilities)
- The RD51 collaboration will steer ongoing R&D activities but will not direct the effort and direction of individual R&D projects
- Applications area will benefit from the technological developments developed by the collaborative effort; however the responsibility for the completion of the application projects lies with the institutes themselves.

RD51 Collaboration



- 75 institutes
- ~ 450 people involved
- Representation (Europe, North America, Asia, South America, Africa)

Freiburg , Germany, May 2010

Collaboration meetings:

RD51 mini week (22-25 February 2010)
RD51 mini week (19-20 July 2010)
RD51 mini week (17-18 January 2011)

5th RD51 Collaboration Meeting; Freiburg (24-27 May 2010)
6th RD51 Collaboration Meeting, Bari (07-10 October 2010)

Bari, Italy, October 2010

MPGD2011 2nd International Conference on Micro Pattern Gaseous Detectors

RD51 Collaboration Internal Notes

2011

RD51-Note-2011-005 –" Modelling of avalanches and streamers by finite elements with COMSOL: step-by-step guide", Notes for the RD51 Simulation School, CERN, Jan. 19-21 2011, (by P. Fonte)
RD51-Note-2011-004 –"Thermal Stretching of Large-Area GEM Foils Using an Infrared Heating Method" (by Michael Staib, Bryant Benson, Kondo Gnanvo, Marcus Hohlmann, Amilkar Quintero)
RD51-Note-2011-003 –"On the operation of a Micropattern Gaseous UV Photomultiplier in Liquid-Xenon" (by S. Duval, A. Breskin, R. Budnik, W.T. Chen, H. Carduner, M. Cortesi, J.P. Cussonneau , J. Donnard, J. Lamblin, P. Le Ray, E. Morteau, T. Oger, J.S. Stutzmann and D. Thers)
RD51-Note-2011-002 –"Infrared scintillation yield in gaseous and liquid argon for rareevent experiments" (by A. Buzulutskov, A. Bondar, A. Grebenuk)
RD51-Note-2011-001 - "Further Developments and Tests of Microstrip Gas Counters with Resistive Electrodes" (by R. Oliveira, V. Peskov, Pietropaolo, P.Picchi).

Internal Notes:

2009 – 7
2010 – 9
2011 – 5

2010

RD51-Note-2010-009 – "Gas Flow Simulations for gaseous detectors" (by D. Abbaneo, S. Bally, H. Postema, A. Conde Garcia, J. P. Chatelain, G. Faber, L. Ropelewski, S. Duarte Pinto, G. Croci, M. Alfonsi, M. Van Stenis, A. Sharma, L. Benussi, S. Bianco, S. Colafranceschi, F. Fabbri, L. Passamonti, D. Piccolo, D. Pierluigi, A. Russo, G. Saviano, A. Marinov, N. Zaganidis, N. Turini, E. Oliveri, G. Magazzu, Y. Ban, H. Teng, J. Cai)
RD51-Note-2010-008 – "Construction of the first full-size GEM-based prototype for the CMS high-eta muon system" (by D. Abbaneo, S. Bally, H. Postema, A. Conde Garcia, J. P. Chatelain, G. Faber, L. Ropelewski, S. Duarte Pinto, G. Croci, M. Alfonsi, M. Van Stenis, A. Sharma, L. Benussi, S. Bianco, S. Colafranceschi, F. Fabbri, L. Passamonti, D. Piccolo, D. Pierluigi, G. Raffone, A. Russo, G. Saviano, A. Marinov, M. Tytgat, N. Zaganidis, M. Hohlmann, K. Gnanvo, M.G. Bagliesi, R. Cecchi, N. Turini, E. Oliveri, G. Magazz`u, Y. Ban, H. Teng, J. Cai)
RD51-Note-2010-007 – "First tests of "bulk" MICROMEGAS with resistive cathode mesh" (by R. Oliveira, V. Peskov, Pietropaolo, P.Picchi)
RD51-Note-2010-006 – "A spark-resistant bulk-micromegas chamber for high-rate applications" (by T. Alexopoulos, J. Burnens, R. de Oliveira, G. Glonti, O. Pizzirusso, V. Polychronakos, G. Sekhniaidze, G. Tsipolitis, J. Wotschack)
RD51-Note-2010-005 – "Characterization of GEM Detectors for Application in the CMS Muon Detection System" (by D. Abbaneo, S. Bally, H. Postema, A. Conde Garcia, J. P. Chatelain, G. Faber, L. Ropelewski, E. David, S. Duarte Pinto, G. Croci, M. Alfonsi, M. van Stenis, A. Sharma, L. Benussi, S. Bianco, S. Colafranceschi, D. Piccolo, G. Saviano, N. Turini, E. Oliveri, G. Magazzu', A. Marinov, M. Tytgat*, *N. Zaganidis, M. Hohlmann, K.* Gnanvo, Y. Ban, H. Teng, J. Cai)
RD51-Note-2010-004 - "Detection and Imaging of High-Z Materials with a Muon Tomography Station Using GEM Detectors" (by K. Gnanvo, B. Benson, W. Bittner, F. Costa, L. Grasso, M. Hohlmann, J.B. Locke, S. Martoiu, H. Muller, and M. Staib)
RD51-Note-2010-003 - "Further evaluation of a THGEM UV-photon detector for RICH and comparison with MWPC" (by V. Peskov, M. Cortesi, R. Chechik and A. Breskin)
RD51-Note-2010-002 - "Imaging of high-Z material for nuclear contraband detection with a minimal prototype of a Muon Tomography station based on GEM detectors" (by Kondo Gnanvo, Leonard V. Grasso III, Marcus Hohlmann, Judson B. Locke, Amilkar S. Quintero, Debasis Mitra)
RD51-Note-2010-001 - "First Tests of MICROMEGAS and GEM-like Detectors Made of a Resistive Mesh" (by R. Oliveira, V. Peskov, F. Pietropaolo, P. Picchi)

RD51 Collaboration Web Page

http://rd51-public.web.cern.ch/RD51-Public

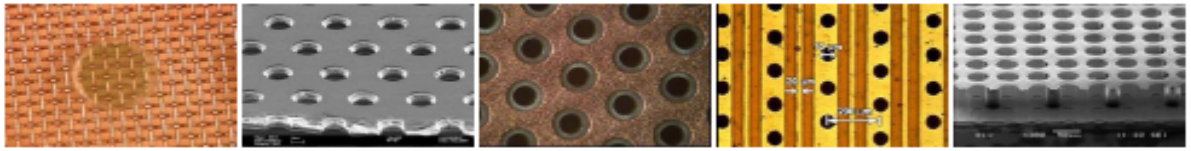
Home | Organization | WG Activities | Meetings | Documents | Safety | Other Links

RD51 Collaboration
Development of Micro-Pattern Gas Detectors Technologies

The proposed R&D collaboration, RD51, aims at facilitating the development of advanced gas-avalanche detector technologies and associated electronic-readout systems, for applications in basic and applied research. **The main objective of the R&D programme is to advance technological development and application of Micropattern Gas Detectors.**

The invention of Micro-Pattern Gas Detectors (MPGD), in particular the Gas Electron Multiplier (GEM), the Micro-Mesh Gaseous Structure (Micromegas), and more recently other micro pattern detector schemes, offers the potential to develop new gaseous detectors with unprecedented spatial resolution, high rate capability, large sensitive area, operational stability and radiation hardness. In some applications, requiring very large-area coverage with moderate spatial resolutions, more coarse Macro-patterned detectors, e.g. Thick-GEMs (THGEM) or patterned resistive-plate devices could offer an interesting and economic solution. The design of the new micro-pattern devices appears suitable for industrial production. In addition, the availability of highly integrated amplification and readout electronics allows for the design of gas-detector systems with channel densities comparable to that of modern silicon detectors. Modern wafer post-processing allows for the integration of gas-amplification structures directly on top of a pixelized readout chip. Thanks to these recent developments, particle detection through the *ionization of gas* has large fields of application in future particle, nuclear and astro-particle physics experiments with and without accelerators.

The RD51 collaboration involves ~ 350 authors, 59 Universities and Research Laboratories from 20 countries in Europe, America, Asia and Africa. All partners are already actively pursuing either basic- or application-oriented R&D involving a variety of MPGD concepts. The collaboration established common goals, like experimental and simulation tools, characterization concepts and methods, common infrastructures at test beams and irradiation facilities, and methods and infrastructures for MPGD production.



Micromegas GEM THGEM MHSP Ingrid

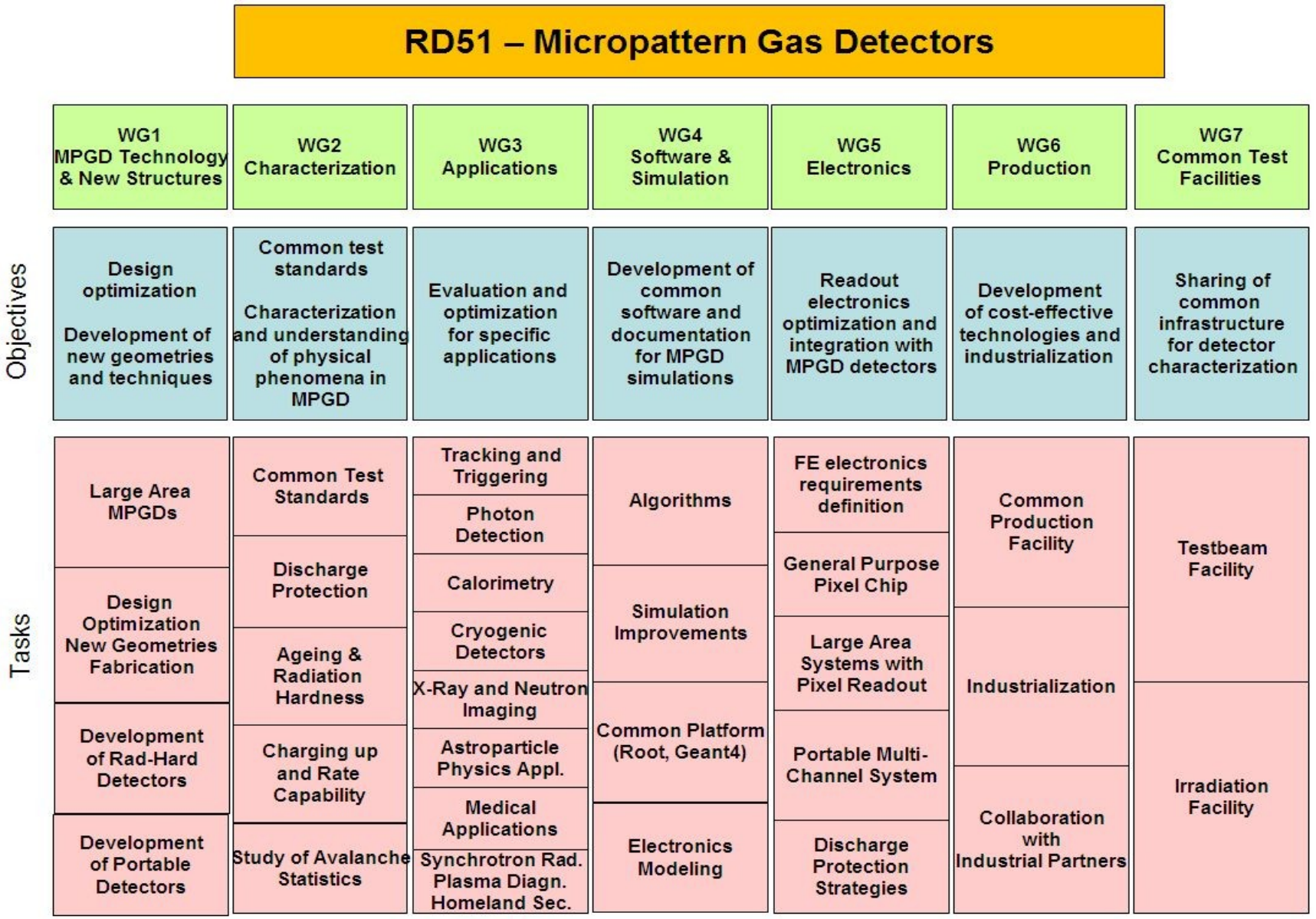
RD51 Conference Contributions, Seminars

http://rd51-public.web.cern.ch/RD51-Public/Documents/ConferenceContributions.html

http://rd51-public.web.cern.ch/RD51-Public/Documents/Seminars.html

RD51 Collaboration – Working Groups

"Transverse organization" of MPGD activities in 7 Working Groups



RD51 Collaboration Organization

Consolidation around common projects: large area MPGD R&D, CERN/MPGD production facility, common electronics developments, software tools, beam tests

WG1: large area Micromegas, GEM; THGEM R&D; MM resistive anode readout (discharge protection); design and detector assembly optimization; large area readout electrodes and electronics interface

WG2: double phase operation, radiation tolerance, discharge protection, rate effects, single-electron response, avalanche fluctuations, photo detection with THGEM and GridPix

WG3: applications beyond HEP, industrial applications (X-ray diffraction, homeland security)

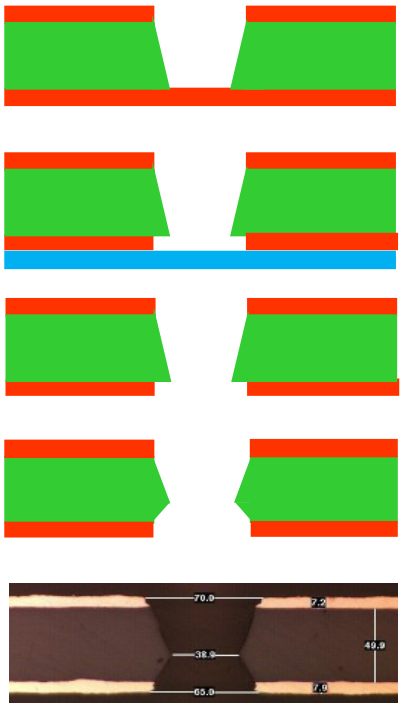
WG4: development of the software tools; microtracking; neBEM field solver, electroluminescence simulation tool, Penning transfers, GEM charging up; MM transparency and signal, MM discharges

WG5: scalable readout system; Timepix multi-chip MPGD readout

WG6: CERN MPGD Production Facility; industrialisation; TT Network

WG7: RD51 test beam facility

WG1: Large area detectors
Single mask GEM technology



Chemical Polyimide etching

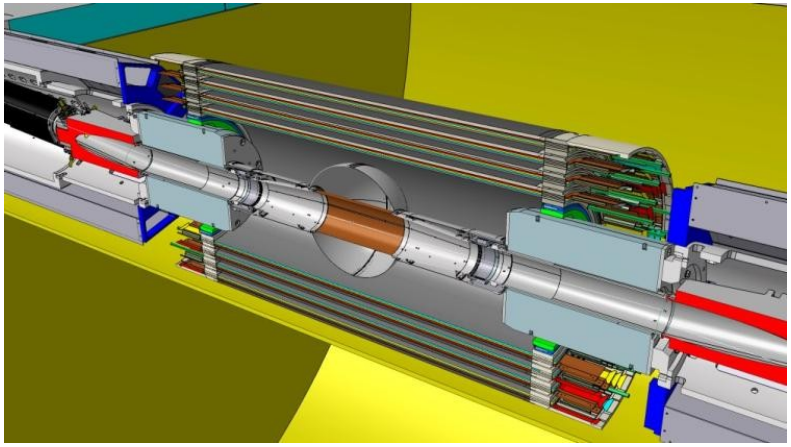
Copper electro etching

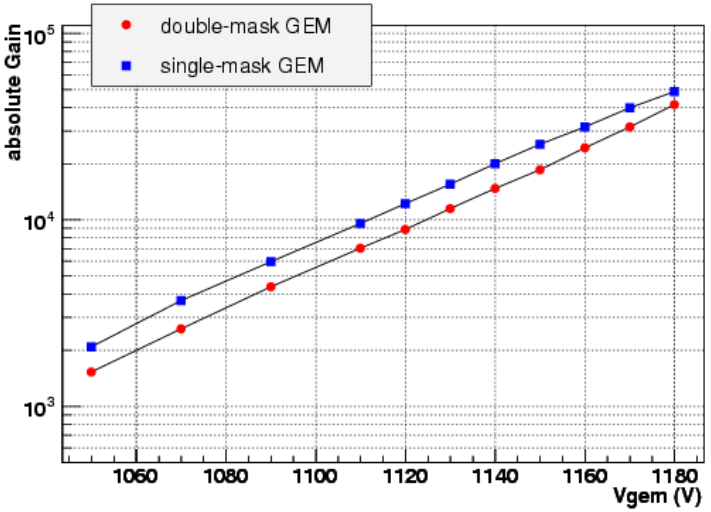
Stripping

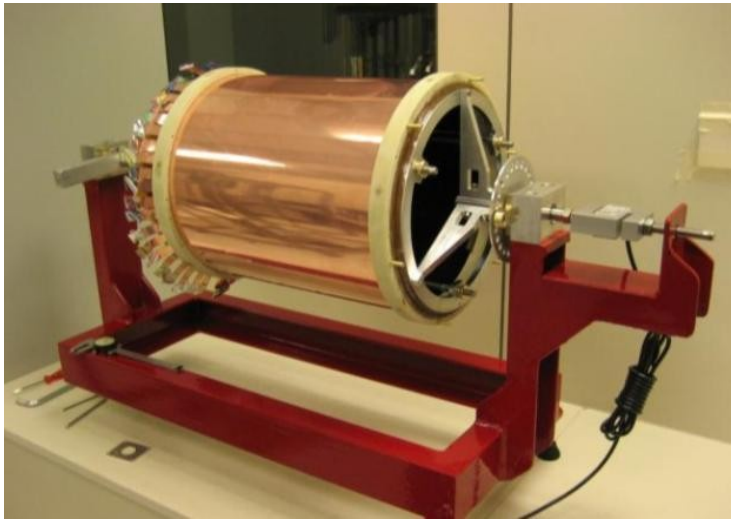
Second Polyimide etching

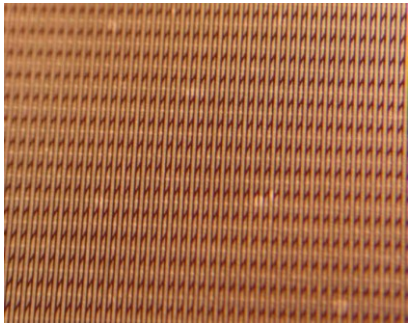
Result

Large area GEMs for KLOE2 tracker





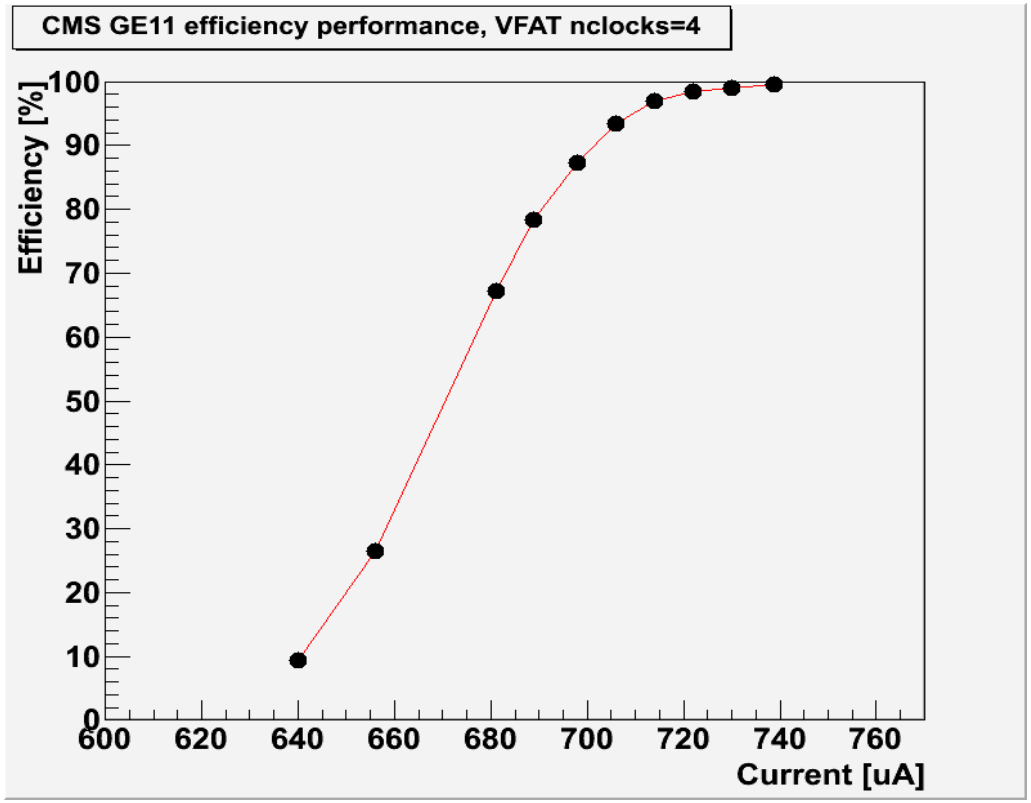




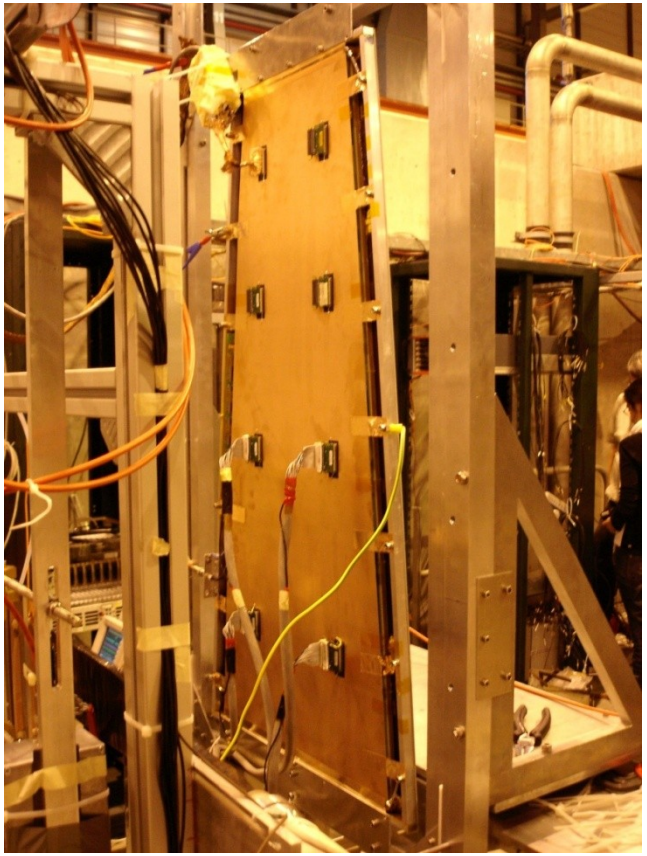
CMS GE1/1 1.6>η>2.1

CMS High Eta MPGD - Workshop (30 September 2010)

15 institutes, 60 participants



Large Prototype: GE1/1 Beam Test @ RD51 setup October 2010



Rate capability : $10^4/mm^2$

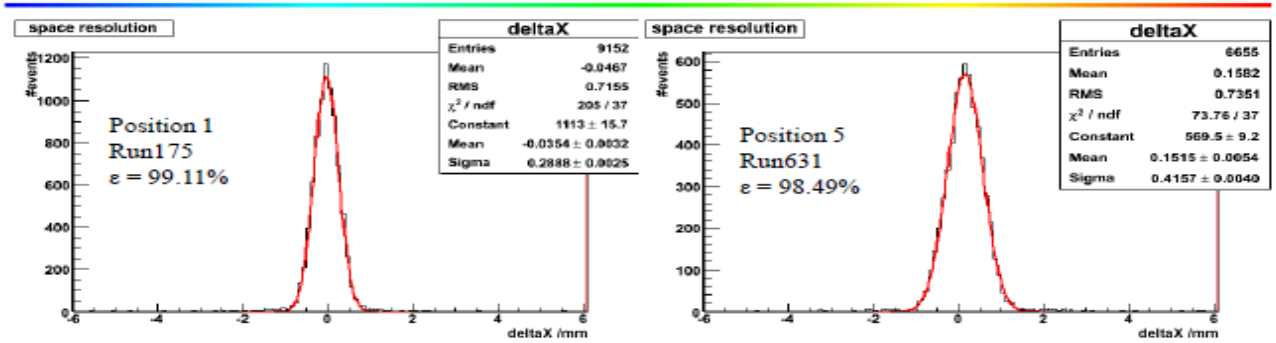
Space/Time resolution: ~ 100 μm / ~ 4-5 ns

Efficiency > 98% ; Excellent Long Term Operation

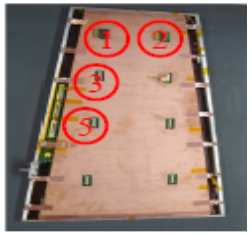
Gas Mixture: Argon CO2 (non flammable mixture)

Large areas ~ 1m x 2m with industrial processes

CMS GE1/1 1.6>η>2.1 project

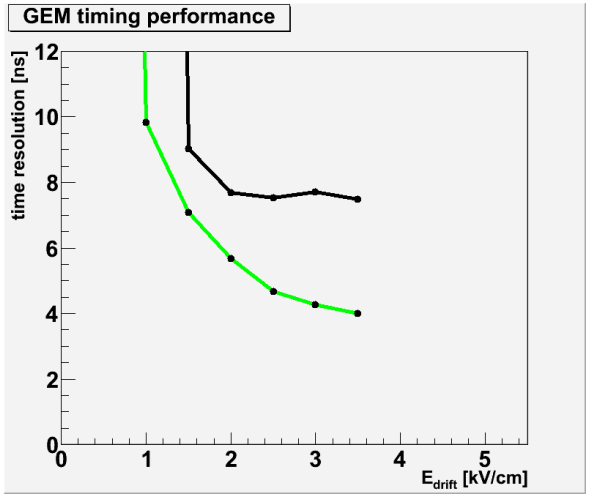


Position	1	2	3	5
space resolution (mm)	0.289	0.288	0.316	0.416
average pitch (mm)	1.06	1.05	1.16	1.49
average pitch/sqrt(12)	0.305	0.304	0.335	0.430



$$resolution \approx \frac{pitch}{\sqrt{12}}$$

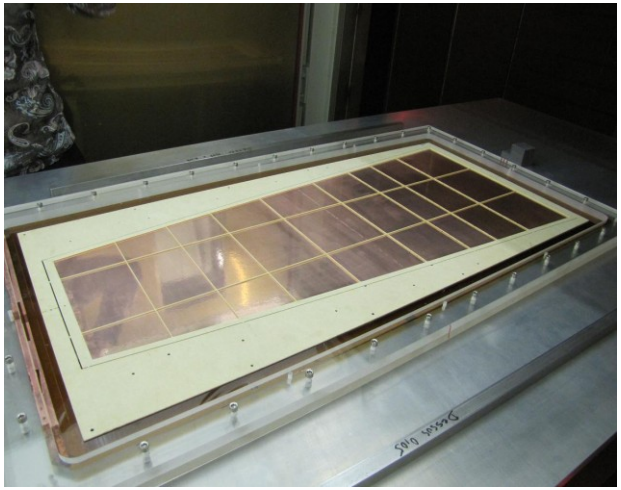
5

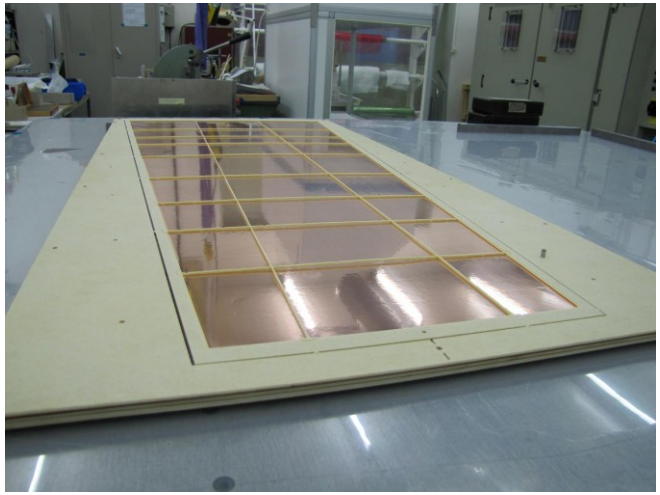


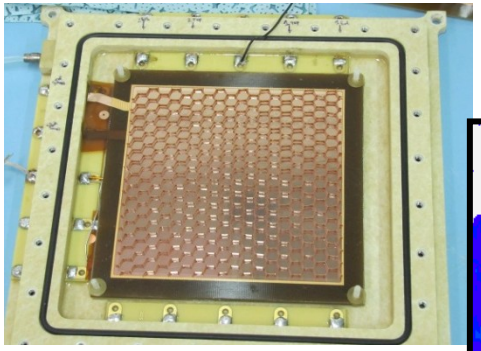
Time resolution for different gas mixtures and geometry:

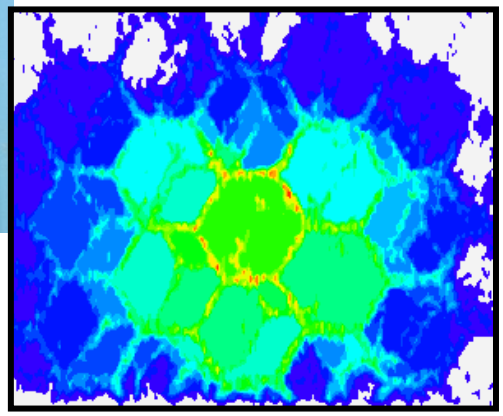
Ar(45):CO_2 (15):CF_4 (40)
[gaps 3/1/2/1]
Ar(70):CO_2(30)
[gaps 3/2/2/2]

CMS GE1/1 1.6>η>2.1 project

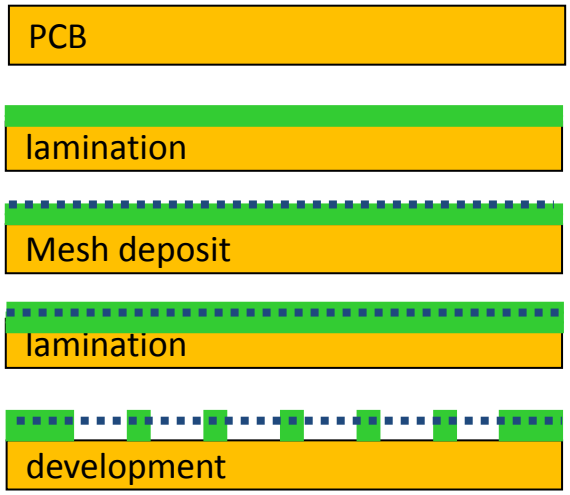


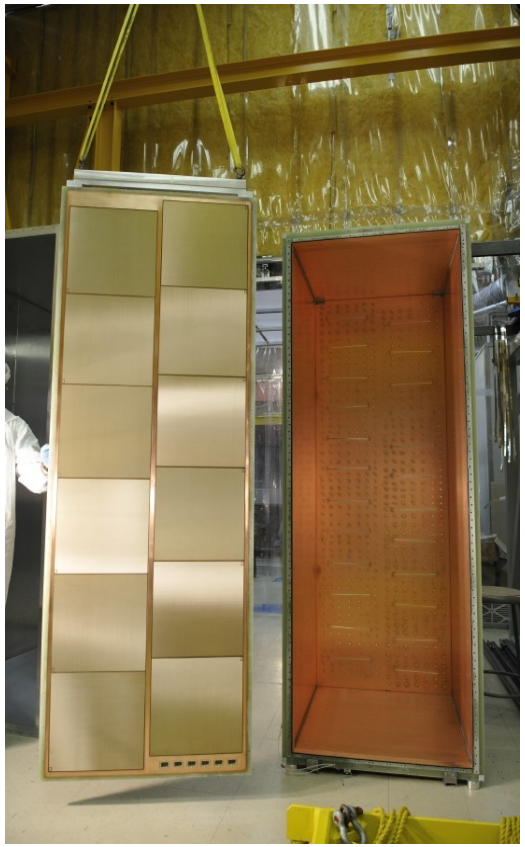






WG1: Large area detectors
Bulk MicroMegas technology

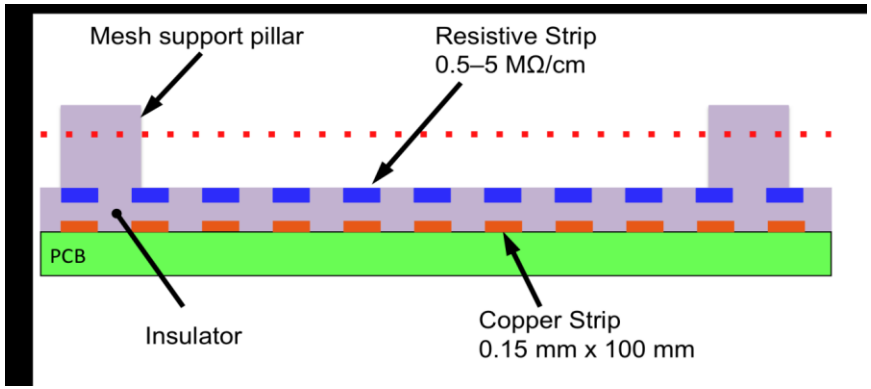


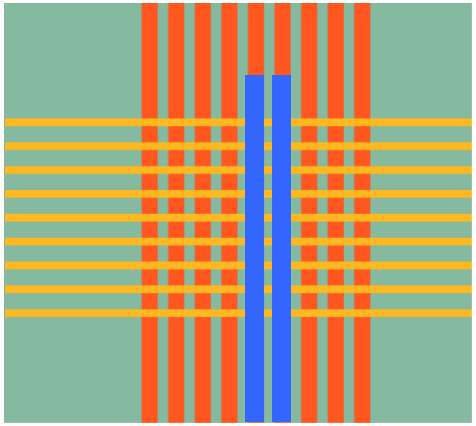


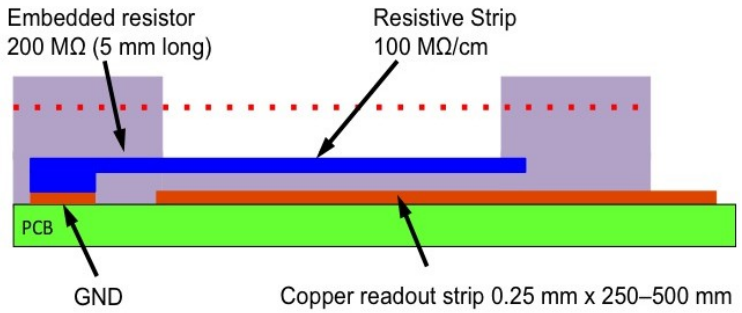
WG1: Bulk Micromegas
DHCAL first m^2

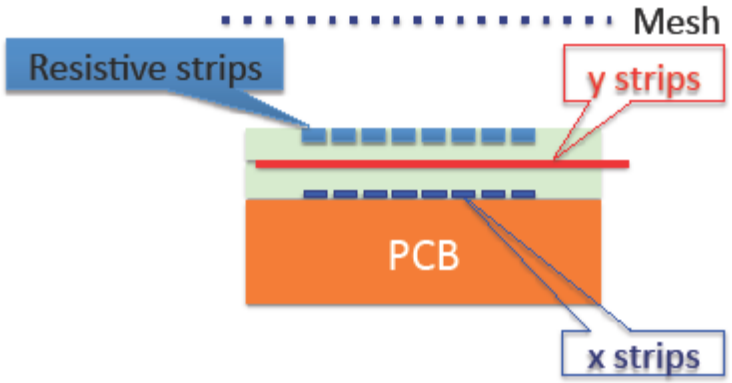
- Fine segmentation $1cm^2$, thickness 8mm for ILC hadronic calorimetry
- Tested in 1kHz beam
- Future microROC much better suited (low noise, longer shaping)
- Tested in the RD51 beam facility

WG1: Large area detectors
Bulk MicroMegas resistive anode and 2D readout









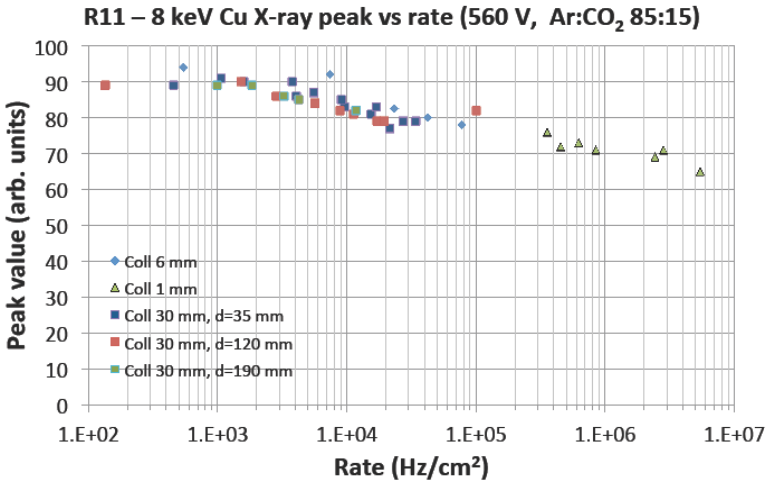
MicroMegas detectors for the upgrade of the ATLAS muon system

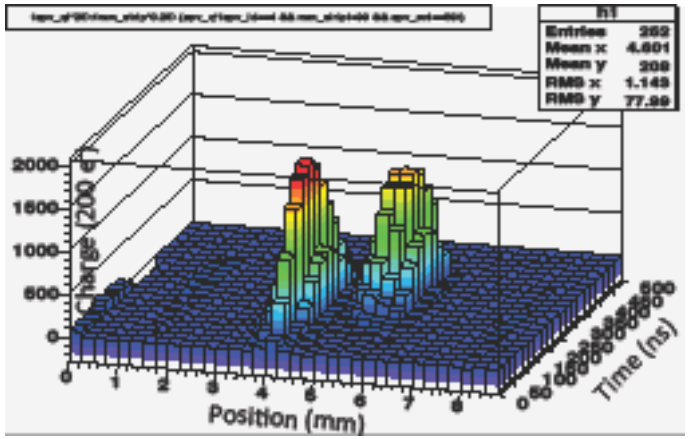
- **Goal**: development of large-area (≈2 x 1 m^2) bulk-micromegas chambers for high-rate applications that combine precision measurement and trigger functionality
- MAMMA Collaboration (21 institutes, including Arizona, Athens, BNL, CEA Saclay, CERN, Naples) in close collaboration with CERN/TE-MPE (R. de Oliveira) & CERN/PH-DT
- Underlying philosophy:
  - Development and evaluation of full-size prototype chambers at CERN and in the collaborating institutes
  - Transfer of know-how to competent industry
  - Large-scale production in industry

1.2 x 0.6 m^2 prototype chamber with 2048 readout strips (0.5 mm strip pitch) during construction in CERN/TE-MPE workshop

MAMMA achievements 2010/11

- Development of resistive-strip protection layer to render MMs insensitive to sparking (paper accepted by NIMA, DOI: 10.1016/j.nima.2011.03.025)
- Extensive tests of the spark-protection scheme in hadron and neutron beams demonstrating excellent performance
  - Stable HV and low currents despite sparks
  - Small gain drop (25% at 1 MHz/cm^2)
  - Spatial resolution: ≤ 40 µm (500 µm strips)
  - Excellent two-track separation
- Development and successful test of 2D readout for MMs with resistive-strip protection
- Construction of 0.6 x 1.2 m^2 MM with resistive-strip protection (0.6 m width is the present limit of machines at CERN; this summer 1.2 m will be possible)





Example of measurement of two tracks separated by 1.5 mm in space and ≈100 ns in time (250 µm pitch)

MAMMA plans for 2011/12

Summer/Fall 2011:

- Construction of second 0.6 x 1.2 m^2 module to be assembled into 2-plane chamber; evaluation in neutron beam (Demokritos/Athens) in May (tbc) and CERN H6 test beam in July
- Construction of 1.2 x 1.2 m^2 chamber with several (4) planes and xy readout (to be installed in ATLAS); evaluation in H6 beam in October
- Development of new VMM1 front-end readout chip (ongoing at BNL); first version expected for October test beam to be read out through SRS (CERN & Arizona)
- Detector long-term tests and ageing studies (CEA Saclay and others)

2012:

- Construction of full-size module-0 chamber with two multilayers and xy readout, compatible with new ATLAS Small Wheel design

0.6 x 1.2 m^2 MicroMegas with resistive-strip protection

Chamber of same dimensions as large CSC chambers presently installed in ATLAS

WG4: MPGD Simulation Tools

C++ version of Garfield:

• C++ class that has the functionality of the Garfield Fortran for gas has been developed. Lots of effort went into benchmarking and validating the new C++ code.
• Gas properties (*i.e.* Magboltz) and primary ionization (*i.e.* Heed) have been implemented.
•Drift path integration algorithms and analytic field calculations had already been translated, and it opens the path to TPC-like calculations.
•Microscopic, MC and Runge-Kutta charge transport techniques are in place.
•Progress is being made in a second generation and final **interface to Geant4** from Garfield C++.
•**Silicon detectors** implementation in Garfield

Maintenance:

•Ionization processes – Heed and MIP (cluster size distribution, electron range and Fano limit)
•Field calculations – BEM method validated for MPGD
•Gas properties – Magboltz tables extended and updated (Ar, Xe, He, Ne; GeH_4,SiH_4, $C_2H_2F_4$)
(Import ant in view of the next generation electroluminescent detectors for dark matter and double beta decays searches)

Generic studies:

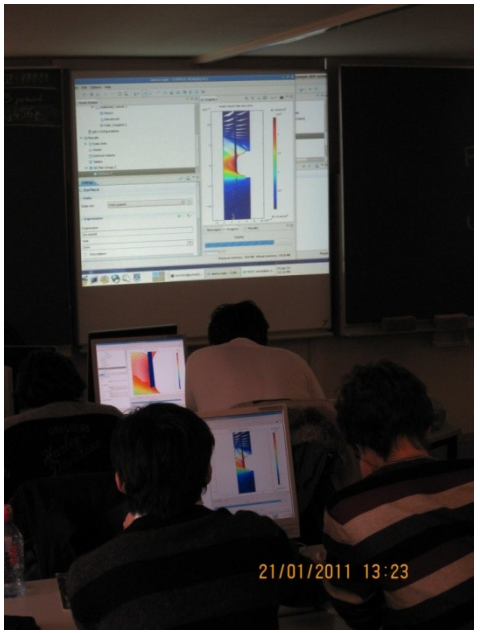
•Penning transfers – published (2010 JINST 5 P05002)
•Avalanche statistics and gain fluctuations –published (NIM 624 (2010)78-84)
•Neutron detection in gases – in progress
•Photon feedback (ALICE TPC & MicroMegas) – in progress

Modeling:

•MicroMegas transfer properties
•GEM charging up

RD51 Simulation School

RD51 Simulation School (19-21 January 2011)



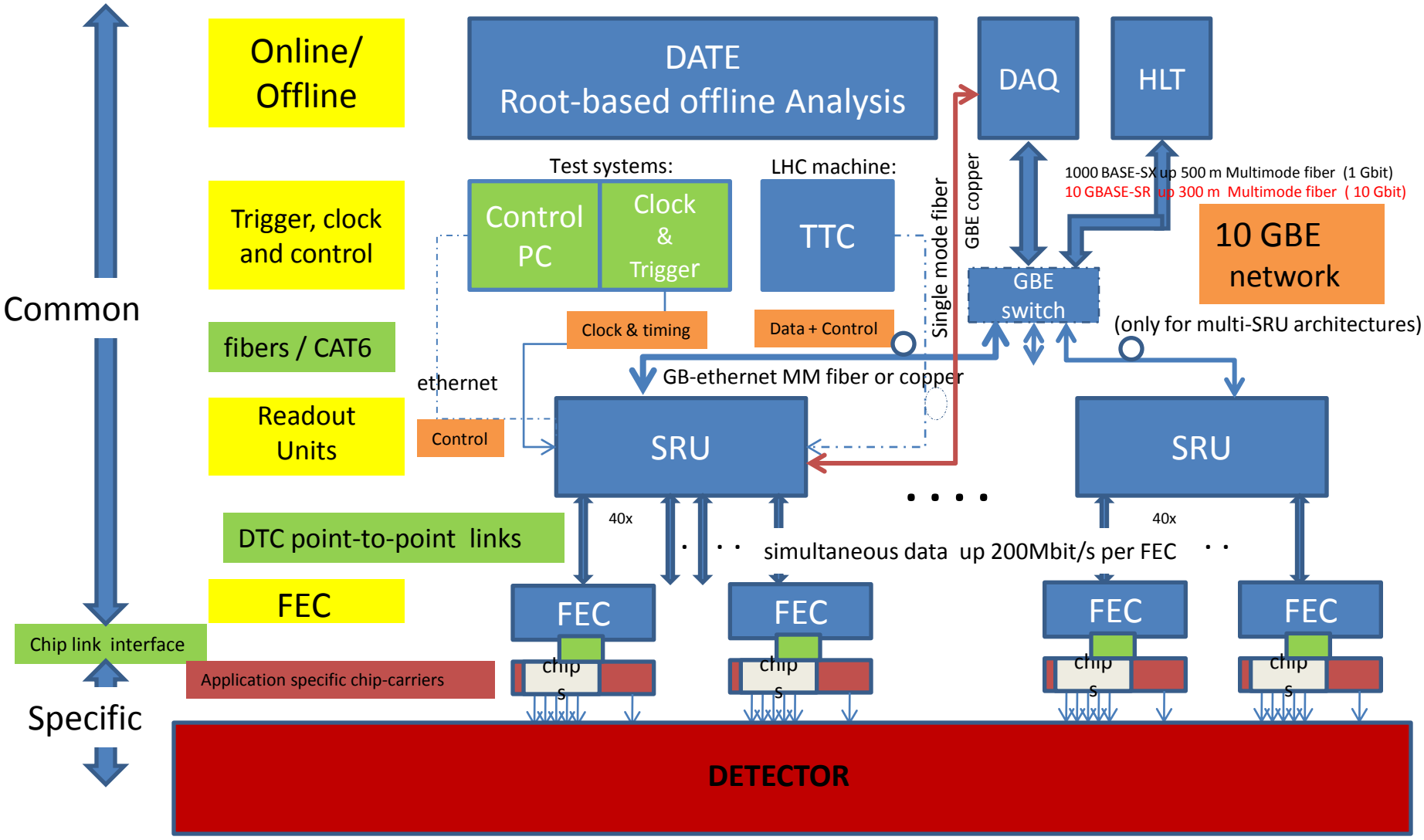
Contents:

Introduction to Geant4
Introduction to FEM, COMSOL
Field calculations
Transport of electrons in small-scale devices
Calculation of signals and their processing

25 participants; enthusiastic feedback

WG5: Electronics for MPGDs

SRS general readout architecture



WG5: Electronics for MPGDs

SRS registered developers and users

Experiment/Team	Detector	Activity
DAQ team ALICE and RD51-CERN	ALICE DAQ upgrade Detector upgrade ALICE (DAQ, CALO etc) SRS system modules	Extension of DATE to Gigabit Ethernet Slow controls Program for SRS R&D and management of SRS Electronic design SRS hybrids, ADC, SRU, Firmware etc
ALICE , CCNU Wuhan, CN and ALICE ORNL Oak Ridge, USA	ALICE DCaL and PHOS Calorimeters ALICE EMCaL and DCal Calorimeter	DTC link protocol and Adapter, Firmware, SRU Electronics Design
ATLAS Coll, MM, short term, CERN, CH	Micromega (Res. Strip) protos	Hybrid adapter to MM chamber
ATLAS Coll. MM, med. Term, CERN USA	N x MICROMEGA DETECTORS	New Hybrids and Adapters
Bonn and Mainz Uni. DE	TPC	Timepix adapter to SRS FEC
Florida Tech. Univ, USA	GEM for Muon Tomography (MTS)	Offline and Online developments link for DATE users RD51
LIP, Coimbra, PT	micropatterned RPC for s. animal PET upcoming application in Astroparticles	Tester...Can take some technical work (manual soldering, cables,etc)
HELSINKI, HIP, Finland	GEM detector and Si- 3D	Online and Offline
Istituto Superiore di Sanita INFN Roma, IT	GEM TRACKER	share information, common dev.
INP, Novosibirsk, USSR	Triple GEM with small angle stereo readout	?
LAPPP, Annecy, Fr	bulk MicroMega	hybrid design for SRS with MICROROC chip
MEXICO, UNAM, MX	TGEM	?
SAHA Inst Nucl Phys,KOLKATA, IN	MICROMEGAS	?
UPV Valencia, NEXT Collaboration, ES	Xe-filled TPC with PMT and SiPM readout via SRS	FEC card design, Firmware modules Online and Offline
USTC Shanghai, CN USTC Shanghai, CN	GEM and MIcroMegas	work on hybrids
Zaragoza Univ, ES	MicroMegas	test and assembly of MM

CERN experiments (large systems)

- ATLAS CSC upgrade MicroMegas
- ALICE EMCaL new readout backend
- NA62 Straw tracker MicroMegas

HEP experiments (medium systems)

- NEXT Collaboration, dual Beta decay
- BUDKER, INP, triple-GEM Deuteron

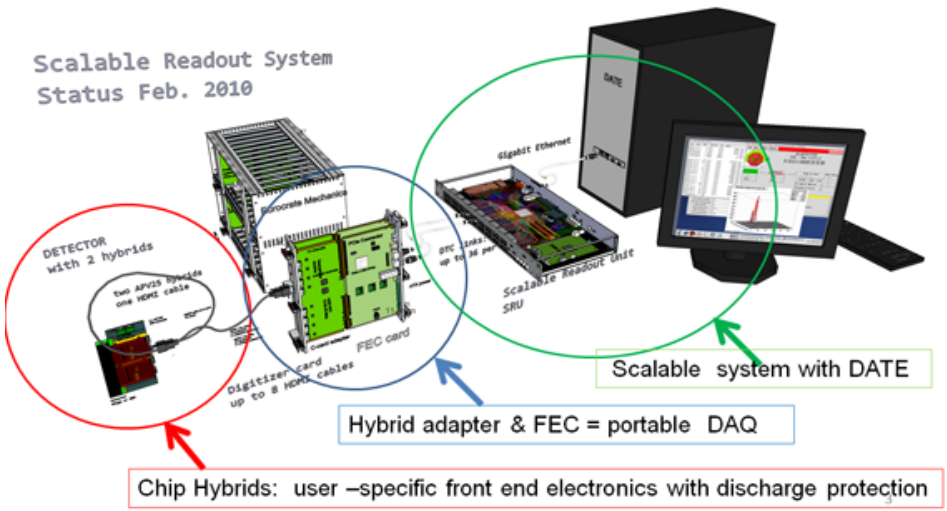
Public usage with Cosmic Tomography

- FIT Florida, homeland security, GEMs
- Geoscienes Azur CRNS - Water quality

R&D with MPGD's (small systems)

- Weizmann Inst, THGEM tests
- Tsinghua Univ, GEM Imaging
- Bonn/Mainz Univ, Timepix readout
- Helsinki HIP, GEM detector
- LIP Coimbra, micropatten RPC, for PET
- INFN Trieste, THGEM photon detection
- MEXICO UNAM, THGEM
- SAHA Kolkatta, MicroMegas
- USTC Shanghai, GEM and MicroMegas
- Zaragoza Univ, GEM and MicroMegas
- CE Saclay, MicroMegas
- ..... some more non-confirmed

physical overview SRS of RD51

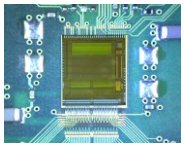


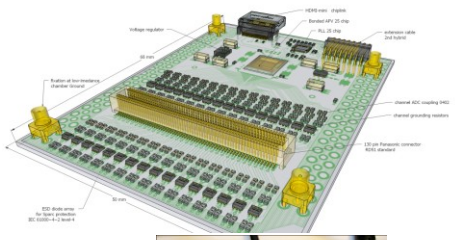
ADC frontend adapter
for APV and Beetle chips

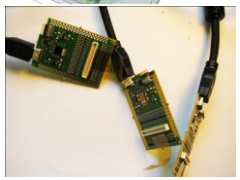
ADC plugs into FEC to make a 6U readout unit for up to 2048 channels
18 ADC V1.0 produced in 2010
18 ADC V1.1 waiting for production 2011

Frontend hybrids

so far all based on APV25 chip
Version 1 proto: 5 working
Version 2 users: 11
Version 3 systems: 16 (CERN PCB + bonding workshops)
320 (ELTOS + Hybrid SA) = ongoing





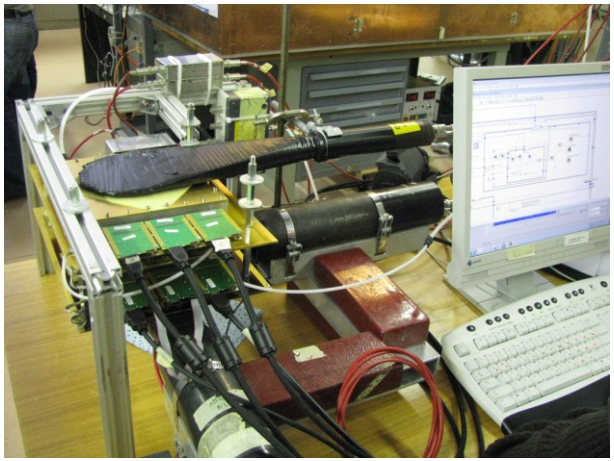


FEC cards

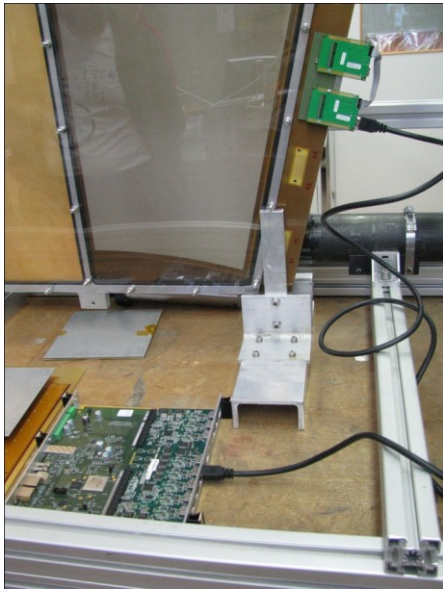
Virtex-5 FPGA, Gb-Ethernet, DDR buffer, NIM and LVDS pulse I/O
High speed Interface connectors to frontend adapter cards
22 FECs V1.1 produced in 2010
16 FEC V1.3 ready for production
all users booked

Industrial partners survey for the production

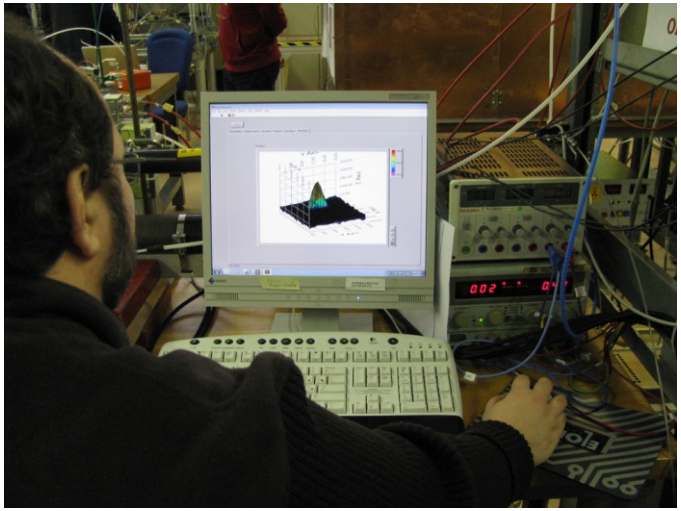
First SRS systems: ATLAS MAMMA



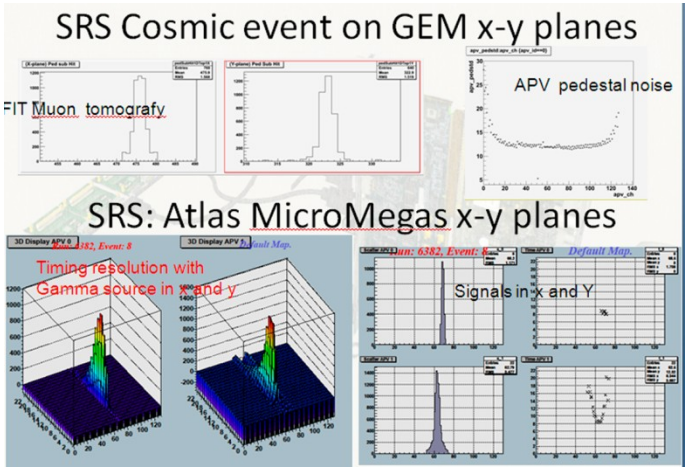
MicroMegas test with cosmic trigger



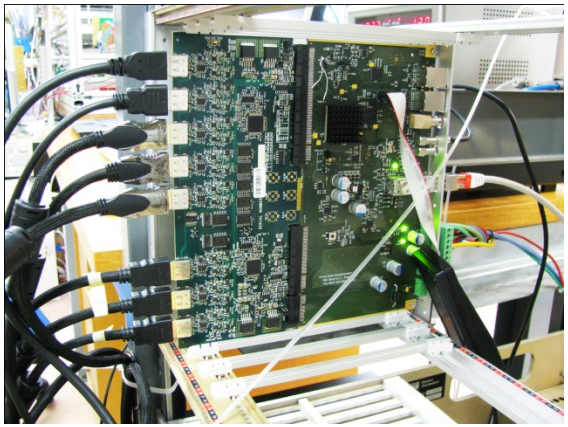
CSC –sized Micromegas



Online display

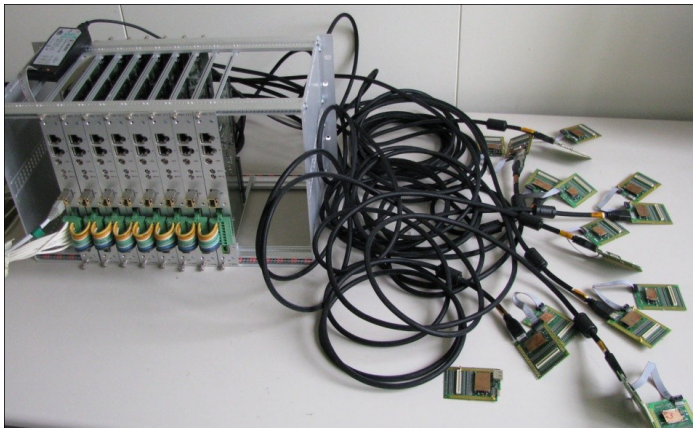


First SRS systems:
Florida Tech – muon tomography: 16 k channels



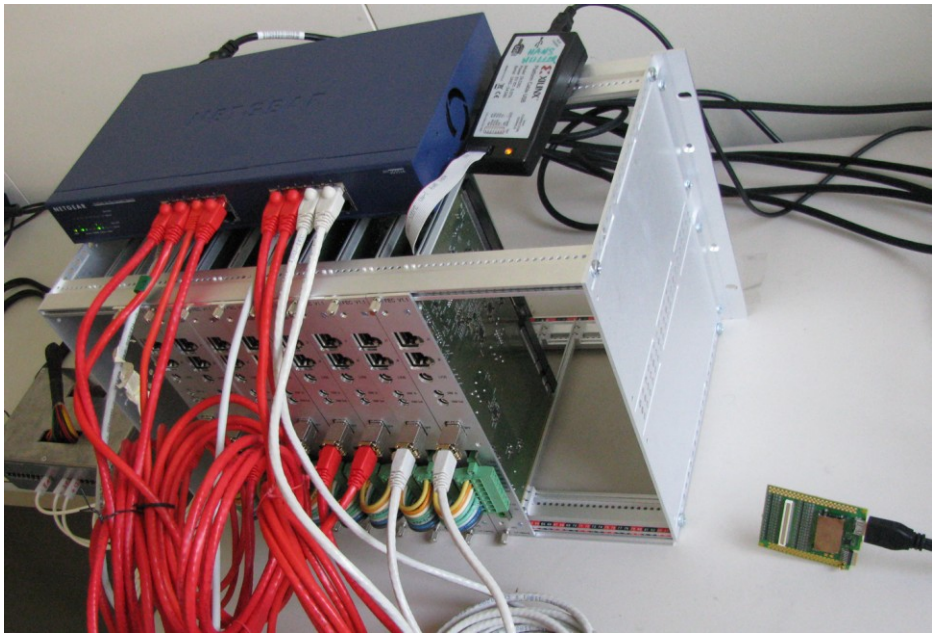
2010: first readout of cosmics with GEM

Now 2011: gearing up for 16 ch system



16 of 148 APV hybrids 128 channels each

2011, March
Readout of 8 FEC's via DATE/UDP and 1 GB switch successful



RD51 SRS system for homeland security
16k GEM channels-> 8 FECs -> GBe->DATE

WG6: EN/ICE Workshop upgrade

History

•GEM 25mm x 25mm	1996
•THGEM 100mm x 100mm	1996
•GEM 330mm x 330mm	1998
•MicroMegas BULK 100mm x 100mm	2001
•MicroMegas BULK 600mm x 400mm	2003

Total review of the processes

•GEM 1m x 450mm	2009
•MicroMegas BULK 1.5m x 500mm	2010
•THGEM 800mm x 400mm	2010

- UV exposure unit limited to 2m x 0.6x → 2.2m x 1.4m

- Resist developer limited to 0.6m width → 1.2m
- Resist stripper
- Copper etcher
- Dryer

- GEM resist stripping limited to 1m → 2m
- GEM electro etch

- GEM polyimide etch limited to 1m → 2m

- Ovens limited to 1.5m x 0.6m → 2.2m x 1.4m

WG6: EN/ICE Workshop upgrade

- Last year, agreement was reached with CERN management to purchase the subset of machines necessary to carry out R&D on large size GEM (2m x 0.5 m) & Micromegas (2m x 1m) and the associated large size read-out boards in the current CERN EN/ICE facility.
- Additional funds for the workshop will come from the FP7 AIDA project

	market survey	call for tender	order	ready
GEM				
– 1 continuous polyimide etcher	x	x	x	06/2011
– 1 Cu electroetch line	x	x		06/2011
Micromegas				
– 1 large laminator	x	x	x	06/2011
– 1 large Cu etcher	x			09/2011
– 1 large UV exposure unit	x	x	x	06/2011
– 1 large resist developer	x			09/2011
– 1 large resist stripper	x			09/2011
– 1 large dryer	x	x	x	06/2011

Machines should be available in 2011 → according to the schedule

MPGD production plan

- Set up a production line being able to face most of the future requests for large MPGD productions (prototype and/or small productions)

- First step: Find adapted machines for large size objects production
  - -We are still in the purchasing process
  - -We need 9 new machines
  - -4 are at the installation process level
  - -2 are not yet delivered but the ordering process is done
  - -3 are at the market survey level

  Initial planning : all machines running mid 2011
  realistic planning : all machines running September 2011

- Second step:
  - -redefinition of all the process parameter related to the new equipments
  - -small prototypes production for

WG6: EN/ICE Workshop upgrade

- CERN investment:
  - Equipments for large size GEM manufacturing (2m x 0.5m)
  - Equipments for large size MicroMegas manufacturing (2m x 1m)
  - Participation of 4 technicians (15% of their time)

- AIDA contribution:
  - Finance a technician during 2 years to:
    - Set up the equipments
    - Produce large prototypes for: (non exhaustive list)
      - SLHC ATLAS Muon detector upgrade
      - CMS Muon detector upgrade
      - KLOE2 inner tracker (Frascati)
      - STAR tracker
      - Panda inner tracker (Munich)
      - Florida Tech university (homeland security)
      - ILC calorimeters (Lapp Annecy, Arlington Texas)
      - Large area, High spatial resolution Tracker at Jefferson Lab
      - Etc…

WG6: Technology Industrialization
Potential partners

THGEM Technology – ELTOS S.p.A. (Italy)

GEM Technology

- New Flex (Korea, Seoul)
- Tech-ETCH (USA, Boston)
- Scienergy (Japan, Tokyo)
- Keerthi Industries (India)
- MicroMETAL GmbH (Germany, Muellheim)

Micromegas Technology

- TRIANGLE LABS (USA, Nevada)
- SOMACIS (Italy, Castelfidarco)
- CIREA (France, CHOLET)

Industrial test runs for each technology foreseen in 2011 after selection of the best candidates

SACLAY bulk MicroMegas workshop

- Very inventive detectors being tried.
- Double-sided : coarse readout on one side, finer multiplexed readout on the other side
- Bulk with thin meshes
- Also trying thick meshes (90% cheaper)
- The Saclay bulk workshop is now ready to help

Clas12 double sided bulk MicroMegas

WG6: Technology Transfer Network

INCREASING EFFICIENCY OF TECHNOLOGY TRANSFER ACTIVITIES IN MEMBER STATES

REPORT ON THE ACTIVITIES OF THE TECHNOLOGY TRANSFER NETWORK WITHIN THE FRAMEWORK OF THE EUROPEAN STRATEGY FOR PARTICLE PHYSICS

CERN-Council-S/049, September 7, 2009)

CERN-Council-S/068, September 7, 2010)

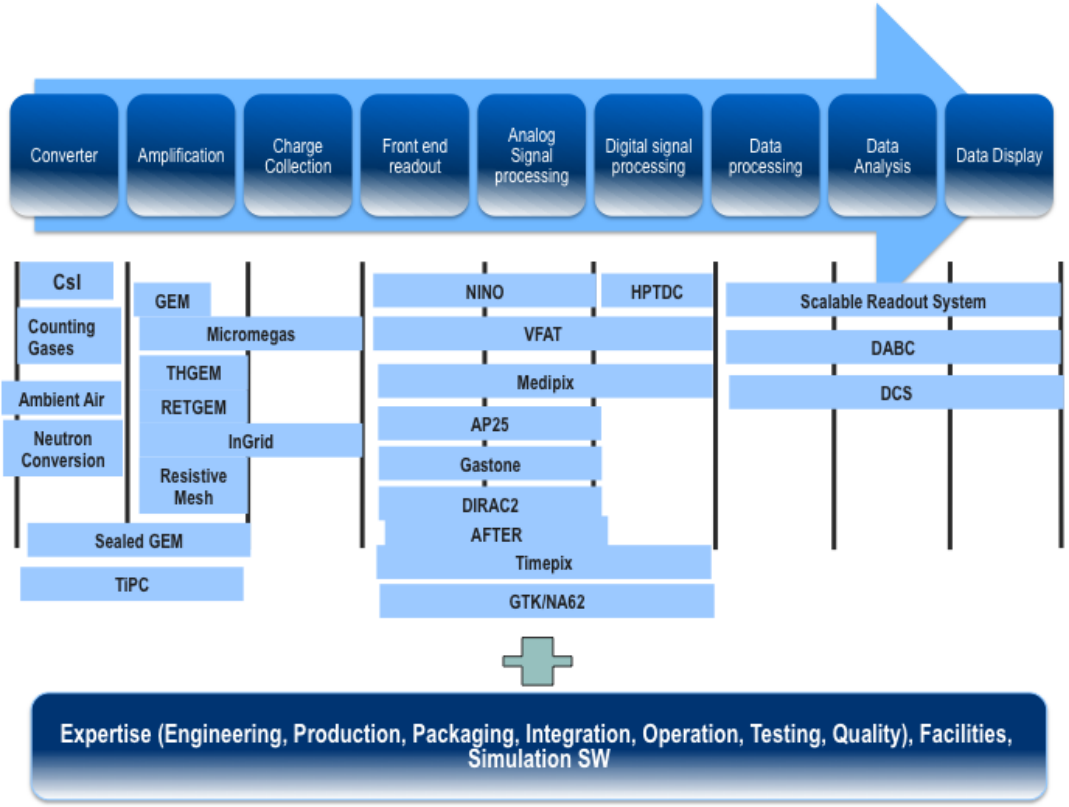
2009: RD51 was proposed as a pilot case for the technology pooling (MPGD technologies are owned by the organizations, members of the TTN)

- **"One-stop licensing for industry" (bridging the gap between institutes and industry)**
- **The IP coming from the HEP research community is better identified and more visible**

2010: In collaboration with RD51, TTN conducted an inventory of the technologies, expertise, production methods, test facilities and patents used

TTN plans to build several technology offers for the RD51/MPGD devices and developments (e.g. industrialization of SRS production)

WG6: Technology Transfer Network

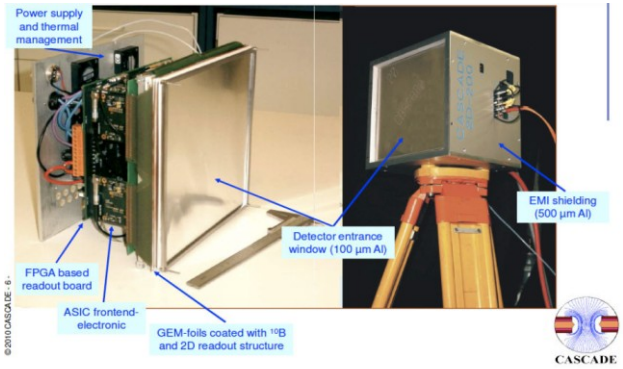


inventory of the technologies, expertise, production methods, test facilities and patents

Institution*	Country
CEA/IRFU	France
CERN	
CHALMERS	Sweden
Copenhagen University	Denmark
CNRS/IN2P3	France
DESY	Germany
EPFL	Switzerland
GSI	Germany
INFN	Italy
JSI Jožef Stefan Institute	Slovenia
PSI Paul Scherrer Institute	Switzerland
National Technical University of Athens	Greece
LIP	Portugal
STFC, Scientific & Technology Facilities Council	UK
University of Sofia	Bulgaria

*TT Network members on September 2010, CPAN/SPAIN officially applied for full membership, KFKI, Hungary observer status

WG6: Technology Transfer Network



Example

CERN

European Organization for Nuclear Research

Scalable Readout System for Multi Channel Detector Systems

Abstract

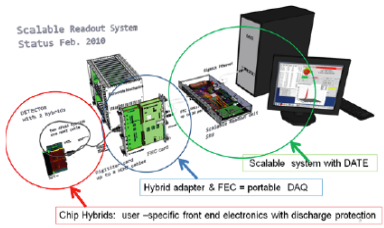
Based on developments for Micro Pattern Gas detectors for the detection of particles in many different application domains, a Scalable Readout System (SRS) for multi channel detectors to accommodate an interface to a wide range of commonly used readout ASICS, a scalability from low to large number of readout channels, a flexible data acquisition package enabling the implementation of various readout architectures and trigger schemes based on widely used industrial standards.

Technology stage

Various prototypes are available off the shelf or can be produced on short term. CERN and RD51 provide support and solutions (data acquisition, chip boards, readout software) for integration of the SRS with user specific detectors and support

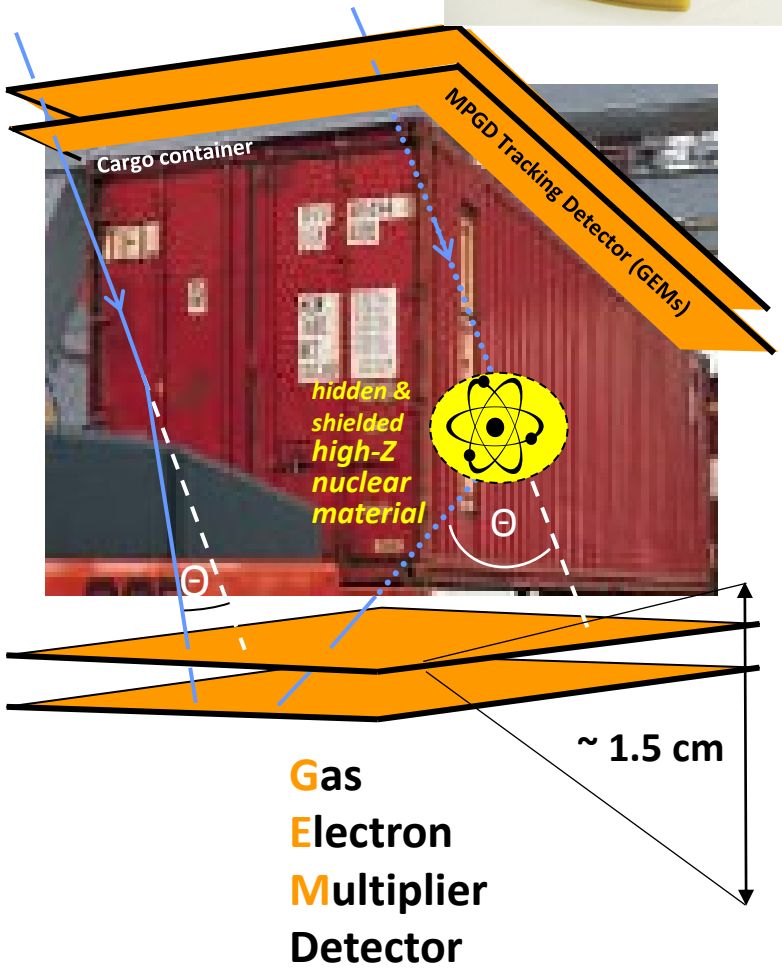
- Scalable from few channel systems up to several millions of readout channels.
- User programmable trigger and clock interface
- Possibility to integrate application specific adapter cards
- Availability of low cost test systems for systems with few readout channels

physical overview SRS of RD51

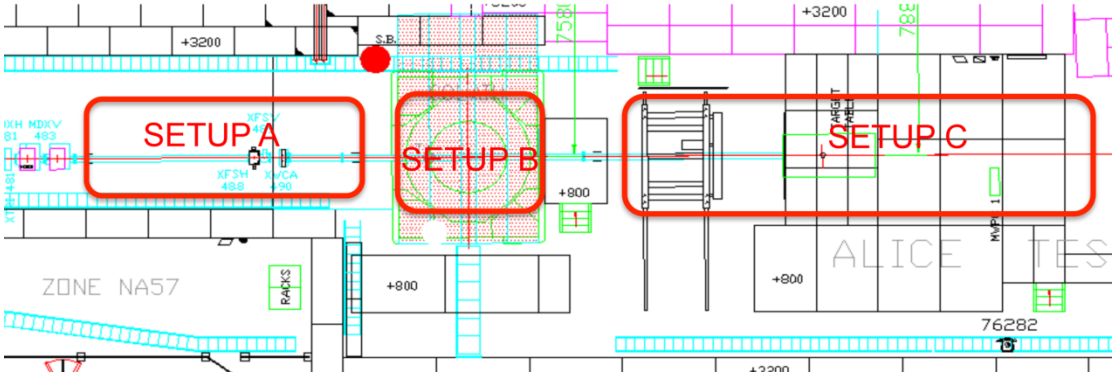


Specifications

- 10 Gigabyte Ethernet standard readout links.
- Programmable Front End Cards

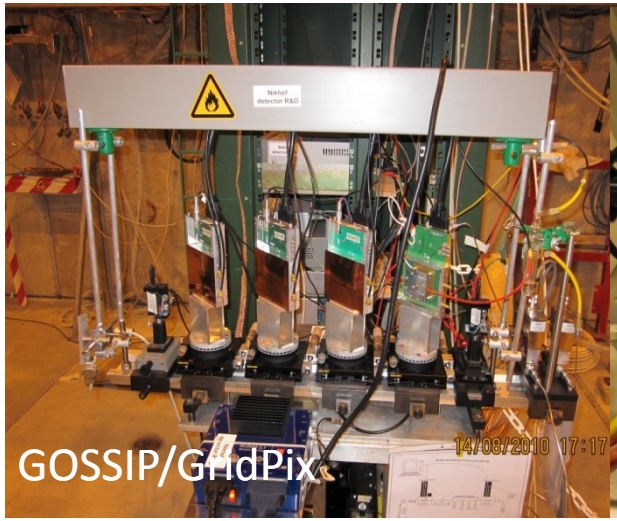


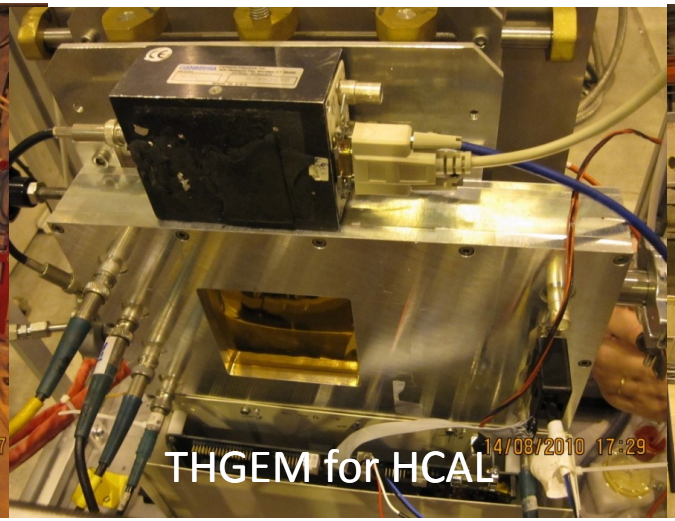
WG7: Test Beam Facility at H4 SPS

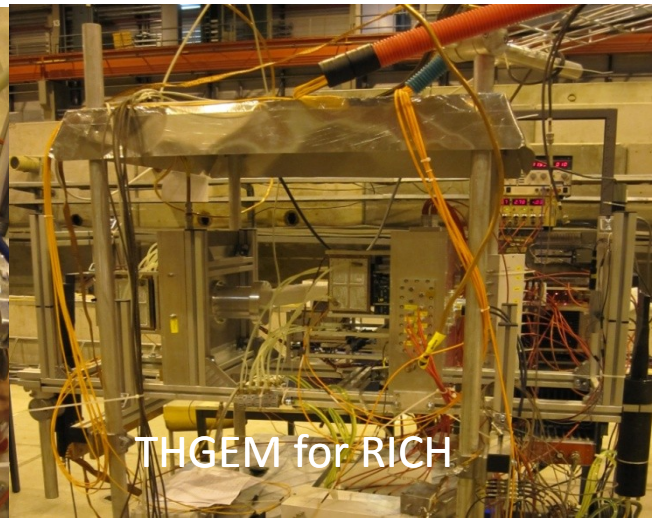


2011 RD51 beam allocation

- 24/June - 4/July (10 days)
- 9/August - 21/August (13 days)
- 17/October - 24/October (7 days)

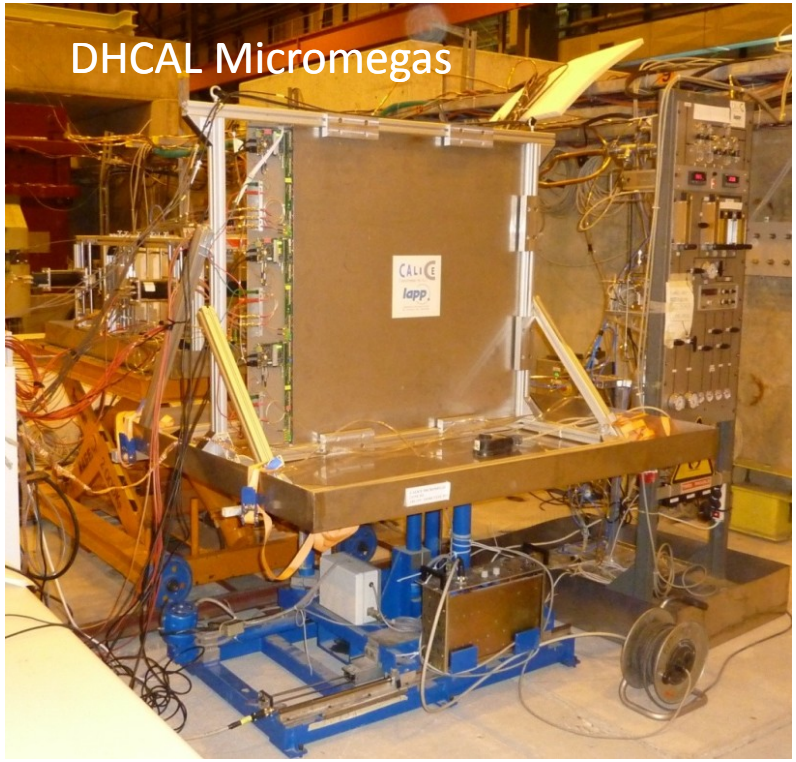


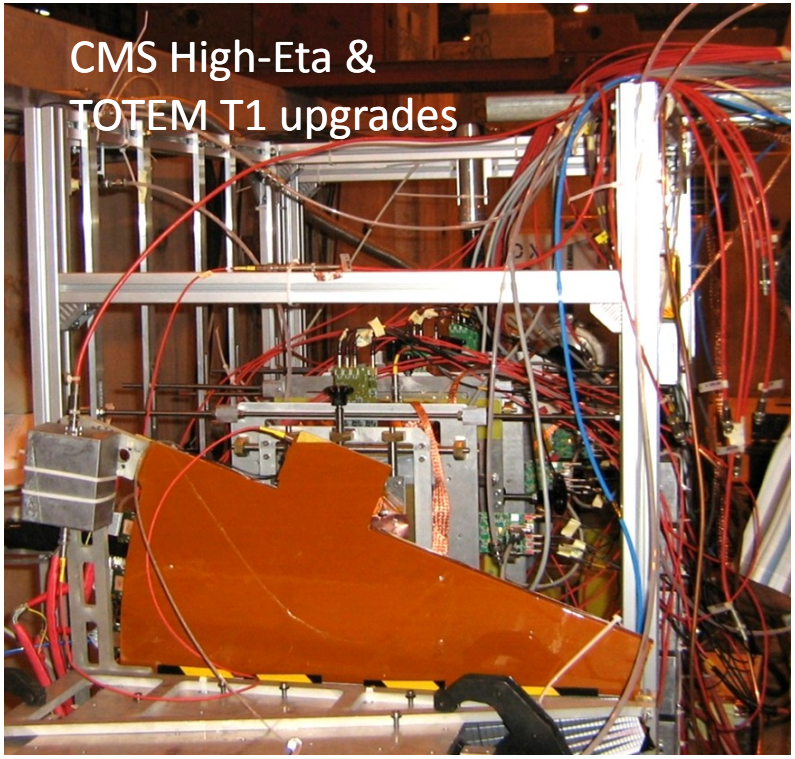




WG7: Test Beam Facility at H4 SPS

- GEM for CMS High-Eta upgrade
- GEM for TOTEM T1 upgrade
- Micromegas TPC for ILC (Saclay)
- DHCAL Micromegas for CALICE
- THGEM for HCALs (Aveiro/Coimbra/UTA/Weizmann)
- THGEM for RICH (upgrade for COMPASS)
- GOSSIP/GridPix (NIKHEF) ATLAS inner tracker upgrade
- THGEM for HCALs (Aveiro/Coimbra/UTA/Weizmann)
- Resistive MicroMegas for JLAB and COMPASS (Saclay)
- MicroMegas TPC for nuclear physics (Demokritos Athens)





Summary and Outlook

- consolidation of the Collaboration and MPGD community integration

- considerable progress in MPGD technologies in particular large area GEM ,THGEM, Micromegas; some picked up by experiments (including sLHC upgrades) for feasibility studies and prototyping

- secured future of the MPGD technologies development through the EN DEM workshop upgrade and FP7 AIDA contribution (upgrade in progress)

- improved MPGD simulation software framework allows for the first applications

- Infrastructure for common RD51 test beam facility (~20 user groups)

- Development of common, scalable electronics (17 development and user groups)

- TTN; contacts with industry for large volume production

2011 RD51 request

Resources requested from CERN as a host lab:

RD51 does not request a direct financial contribution from CERN.

The collaboration would like to ask for the following resources and infrastructure at CERN:

- Access to irradiation and test beam facilities (including the possibility to keep "semipermanent" setup). The collaboration foresees typically 2 annual test beam campaigns each of a few weeks duration.
- Privileged access to CERN TS-DEM Printed Circuit Workshop (similar to present availability level). Participation in investments for production infrastructure to stay in line with technology advances.
- Access to Silicon Bonding Laboratory
- Access to central computing resources and Grid access for MPGD simulations.
- Limited amount of office space

Excellence in Detectors and Instrumentation Technologies
CERN, Geneva, Switzerland - 31 January - 10 February 2011

"GEM Detectors"

The principles of GEM-based detectors and their applications will be explained. GEM detectors will be assembled, and afterwards tested in X-ray stands. Concepts such as detection of X-rays will be explained and pulse height gain, and counting rate measurements will be carried out.

Professors of excellence and Tutors: L.Ropelewski, G.Bencivenni

"GridPix and Micromegas"

The set-up consists of two tests stations:

A complete GridPix/Gossip detector(s): PolaPix, Dice, Gossip including gas system, new miniHV supplies and readout systems. Students will operate the set-up and take data with various sources and cosmic rays, followed by data analysis: track fitting, dE/dX, interaction of ionization radiation with gas.

The second set-up consists of a 10x10 cm2 bulk Micromegas read out by a charge preamp, amplifier- shaper and a Multi-Channel analyzer, and a 1726-channel TPC in a gasbox, read out by T2K electronics. Fundamental concepts such as X-ray conversion, diffusion, electron collection and gas amplification will be understood via measurements with a full DAQ and analysis chain.

Professors of excellence and Tutors: H.van der Graaf, P.Colas