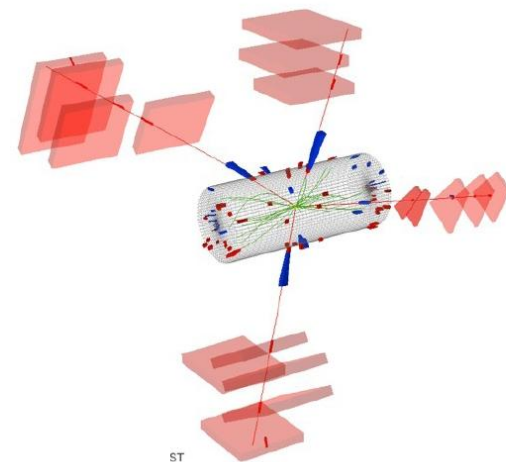


# Trends and synergies in gaseous detector R&D



M. Abbrescia, A. Cardini, P. Dupieux, G. Graziani,  
P. Iengo, C. Lipmann, O. Kortner, R. Santonico, A. Sharma  
ECFA HL-LHC experiments workshop 2014

# Trends: performance increase



We have to develop and build a new generation of gaseous detectors with performance an order of magnitude better than the present.

**RPCs:** Improve the rate capability

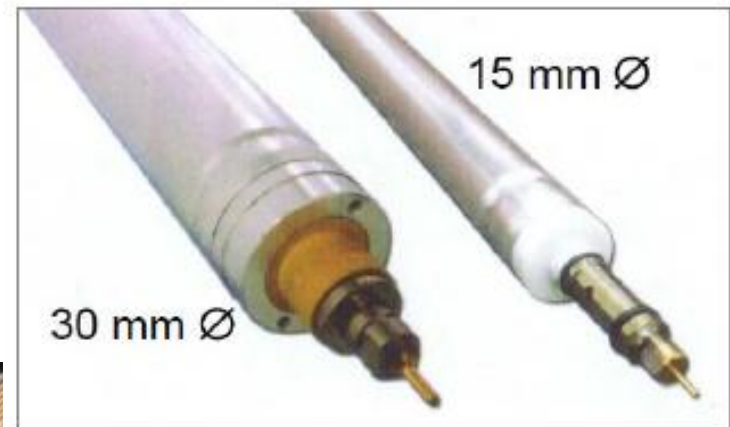
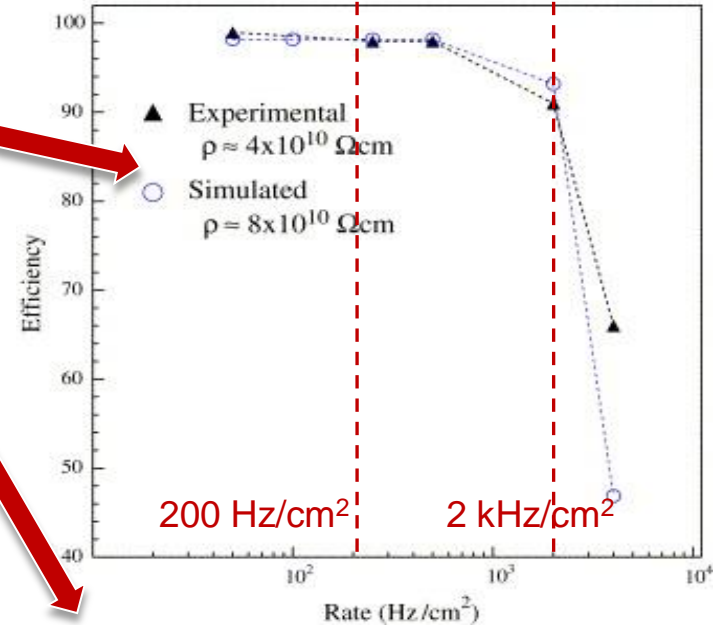
**MPGDs:** Increase covered surface

**DTs, CSCs, TGCs:** assuring same performance at higher rates

**All detectors:** Mantain a stable performance after integrating  $3000 \text{ fb}^{-1}$

|                        | Detector surface   | Foil Area           |
|------------------------|--------------------|---------------------|
| LHCb Muon system (now) | 0.6 m <sup>2</sup> | 4 m <sup>2</sup>    |
| ALICE TPC              | 45 m <sup>2</sup>  | 180 m <sup>2</sup>  |
| CMS Muon system        | 335 m <sup>2</sup> | 1100 m <sup>2</sup> |
| ATLAS (MMs)            | 160 m <sup>2</sup> | 1280 m <sup>2</sup> |

G E M S

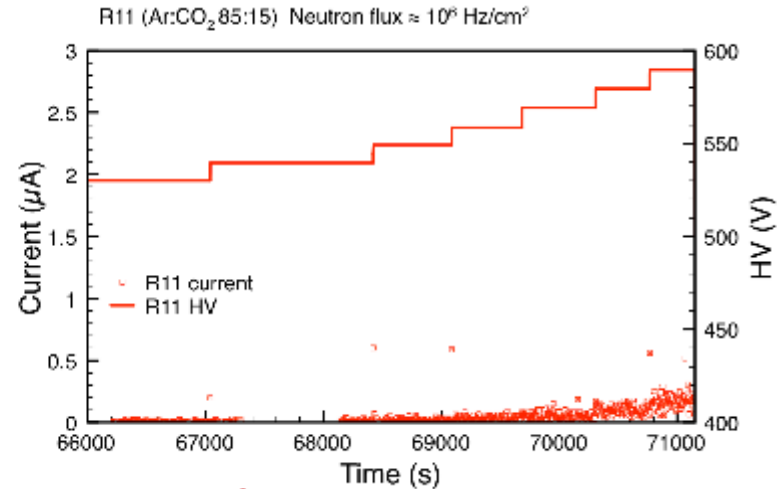
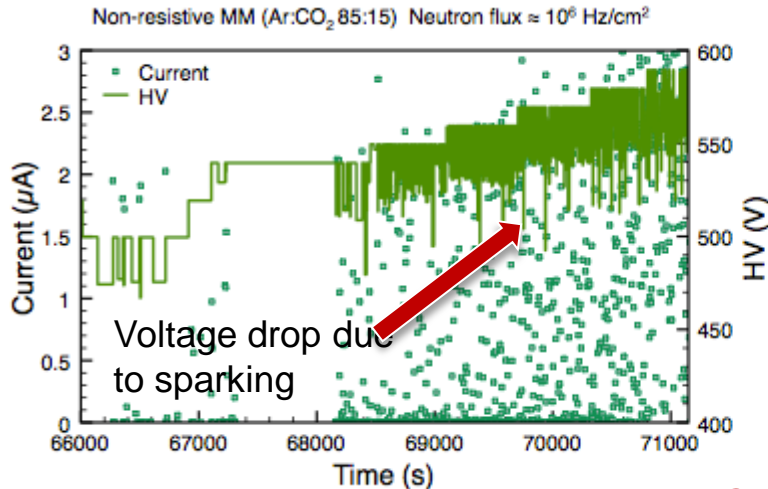


# Trends: cross-fertilization



Major break-throughs have arrived when concepts originally developed in one field have been applied elsewhere

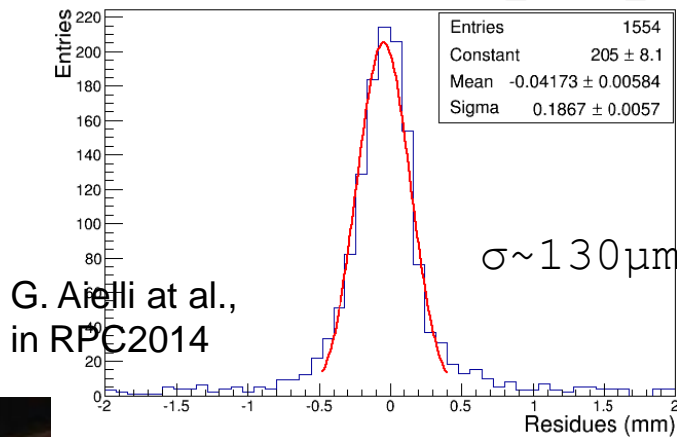
## Use of resistive layers to protect MPGD (RETHGEM, MMs) from sparks



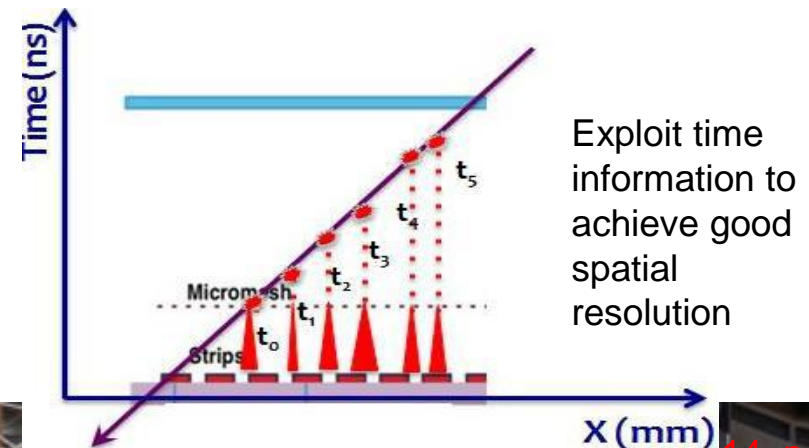
T. Alexopoulos et al.  
NIM A 640 (2011) 110

## Exploiting full spatial resolution in RPCs

## The $\mu$ TPC method for inclined tracks



G. Aielli et al.,  
in RPC2014



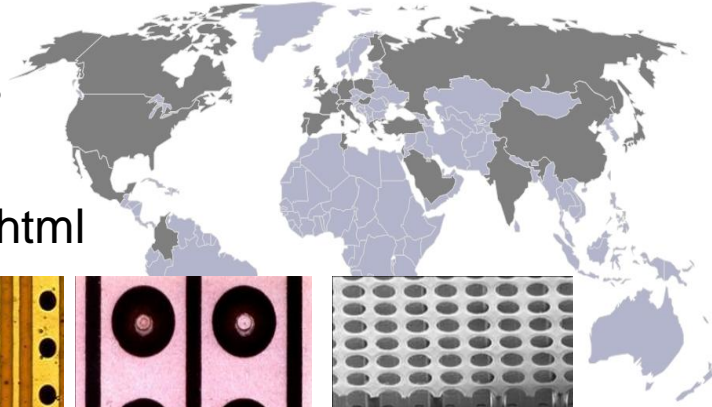
# Synergies: sharing ideas



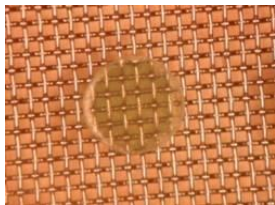
## RD51 MPGD collaboration

- ✓ Environment where groups performing R&D on various detectors meet
- ✓ Where simulation people meet with experimentalists
- ✓ Electronics and detector people meet

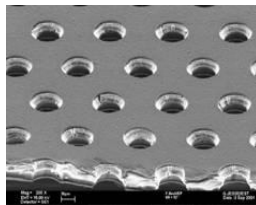
~450 Authors from 75 Institutes from 25 Countries



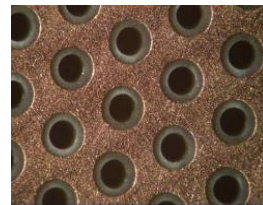
<http://rd51-public.web.cern.ch/rd51-public/Welcome.html>



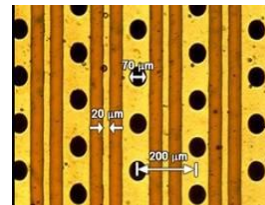
MicroMegas



GEM



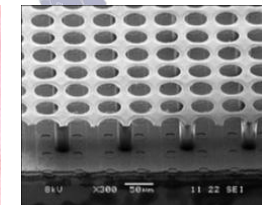
THGEM



MHSP



MicroPIC



Ingrid

## The new born – still a proposal - RDxx for RPCs

- ✓ RPCs exist in many flavours (trigger and timing RPCs, many materials)
- ✓ Proposed to improve the communication already existing thanks to the bi-yearly RPC workshops

The ECFA Preparatory Groups  
Excellent environment to share ideas

XII Workshop on Resistive Plate Chambers and Related Detectors  
RPC2014 Tsinghua Beijing

# Synergies: common test facilities



The set-up of a facility to test the new generation detectors in conditions as similar as possible to the ones during HL-LHC is mandatory

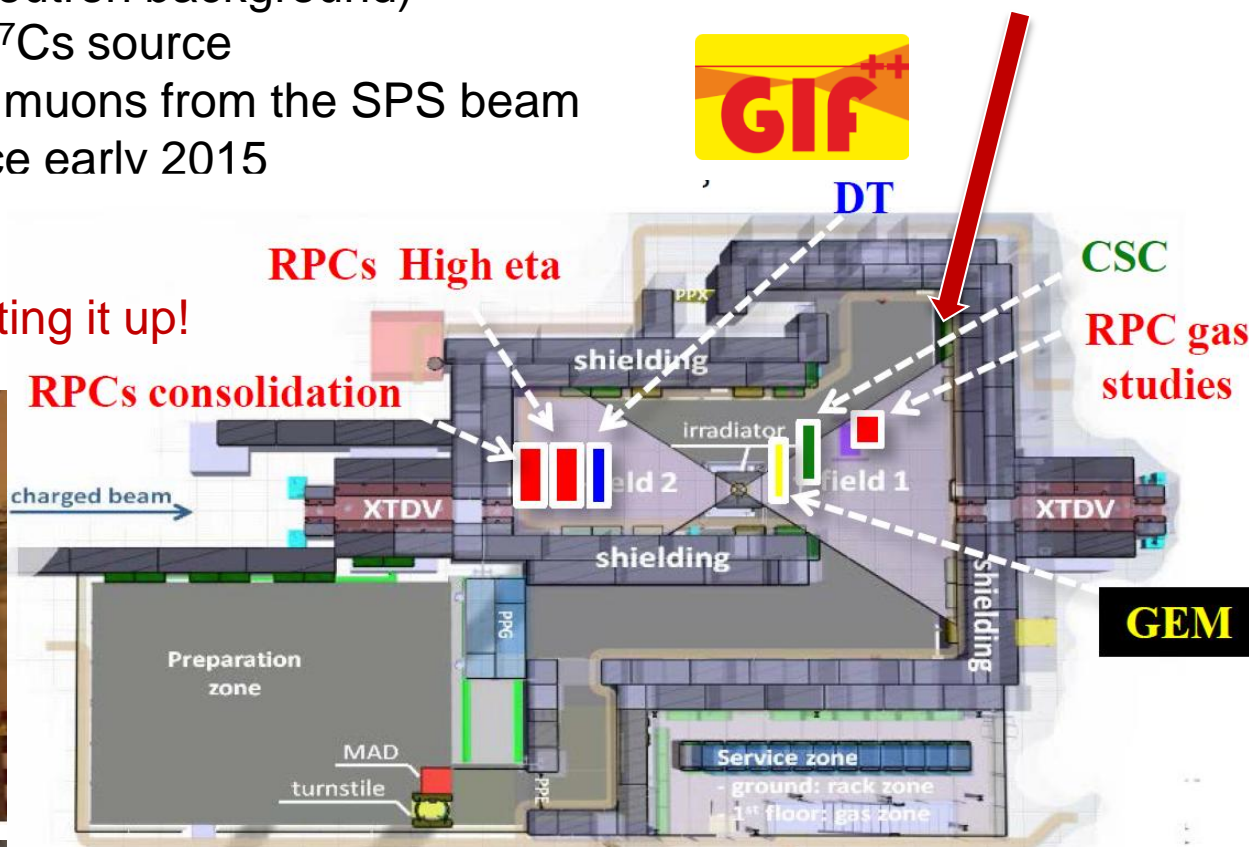
- i.e. irradiation on the whole detector surface (to simulate photon and neutron background) provided by a 16.7 TBq  $^{137}\text{Cs}$  source
- Detection performance on muons from the SPS beam
- ✓ Plan to be operational since early 2015

The GIF++ as we want it



The GIF++ as it is now:

many thanks to the people setting it up!



# Synergies: common issues



There are common issues that are naturally dealt with in a common approach

## Example: the Quest for Eco-Gas

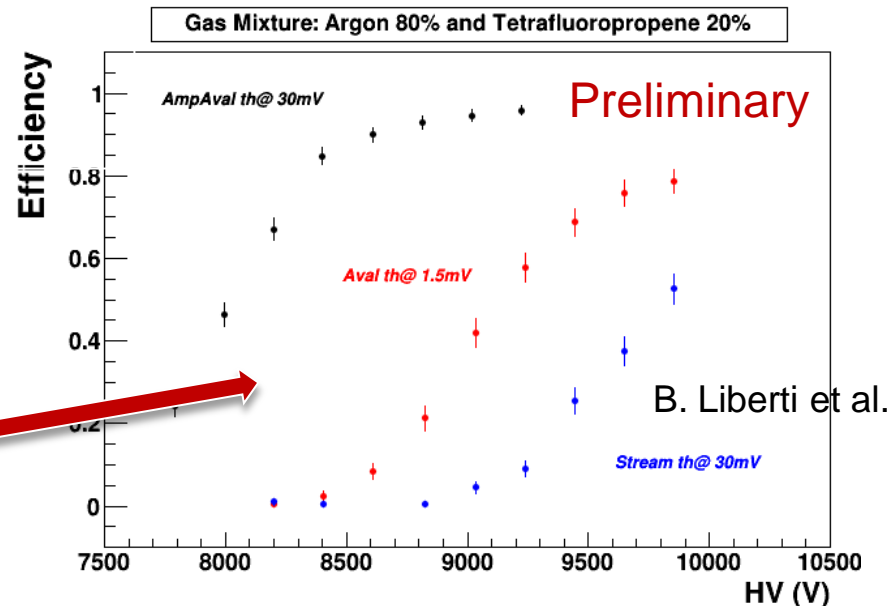
Due to the new regulations deriving from the Kyoto protocol the use of components of RPCs ( $C_2H_2F_4$ ) and GEMs ( $CF_4$ ) gas mixtures might be restricted

➤ Essentially due to their high (limit being  $<150$ ) Global Warming Power:  
 $GWP(C_2H_2F_4) = 1430$     $GWP(CF_4) = 6500$     $GWP(SF_6) = 6500$  (with respect to  $CO_2$ )

A long R&D program is needed to analyze all the proposed gases and variants

Tests already started in various laboratories around the world (CERN, Frascati, Ghent, Rome, ...) in a **synergic way**

One of the gas mixtures tested:  
 Ar/Tetrafluoropropane 80-20 (2 mm gap)



# Conclusions

OCCASIONS

The HL-LHC is an extraordinary occasion to develop a new generation of gaseous detectors, with greatly improved performance

✓ Must be done putting together and exploiting at maximum the limited resources available

## The path toward HL-LHC has just started



Looking back at the last year, impressive progresses have been done

- Most experiments are in the process of writing down their ideas for Phase II (in terms of Technical Proposals, Letters Of Intent, Technical Design Reports)
- Collaborative efforts have already started
- New ideas have already been proposed to tackle the challenges of HL-LHC

The role of common playgrounds, where to share ideas and resources is vital

- R&D for LHC experiments is becoming a huge collaborative effort, to be carefully planned and steered

