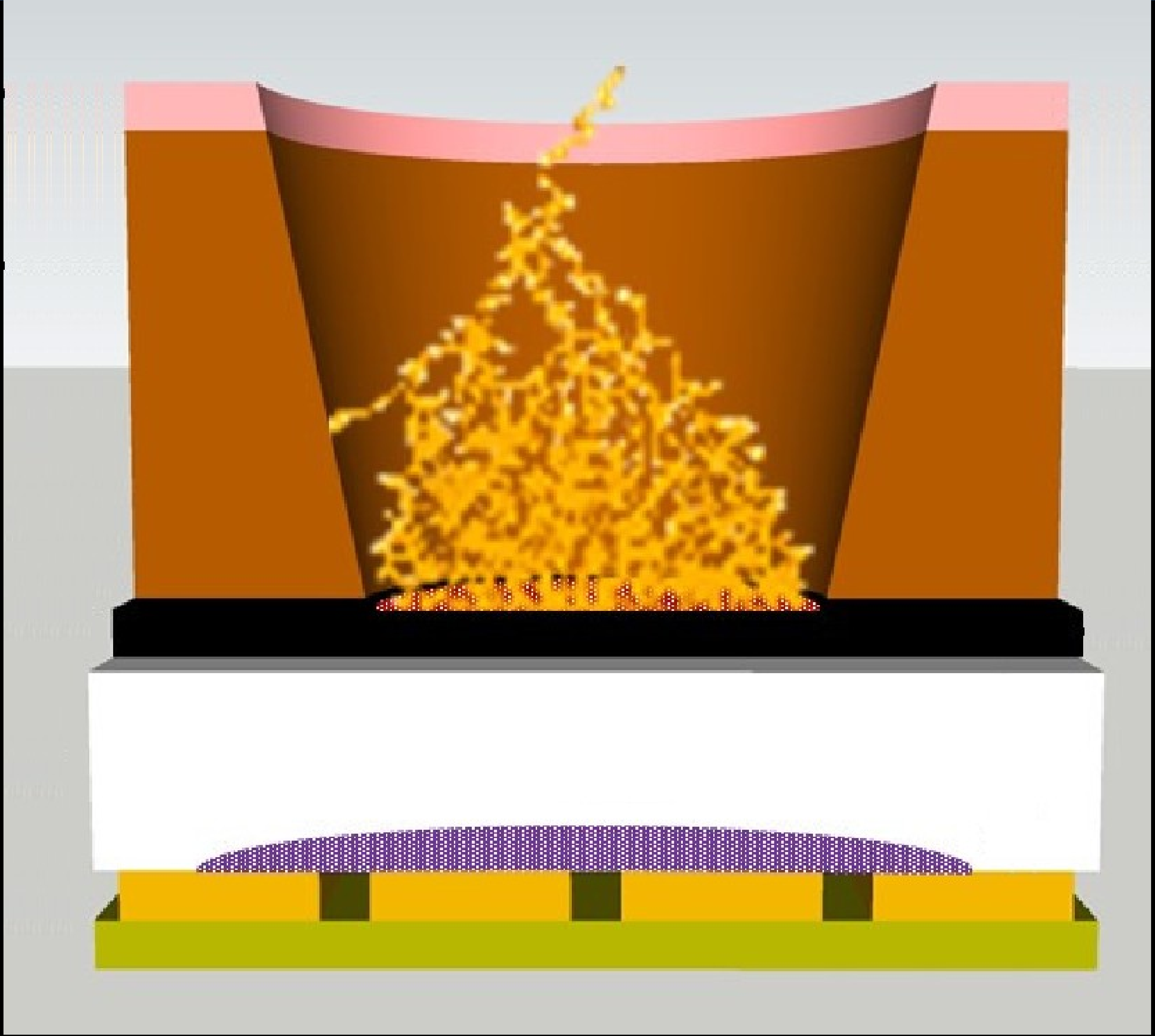
Latest MPGD: µ-RWell detector



Gabriel CHARLES

One thing before we begin

The micro-Resistive WELL is proposed in

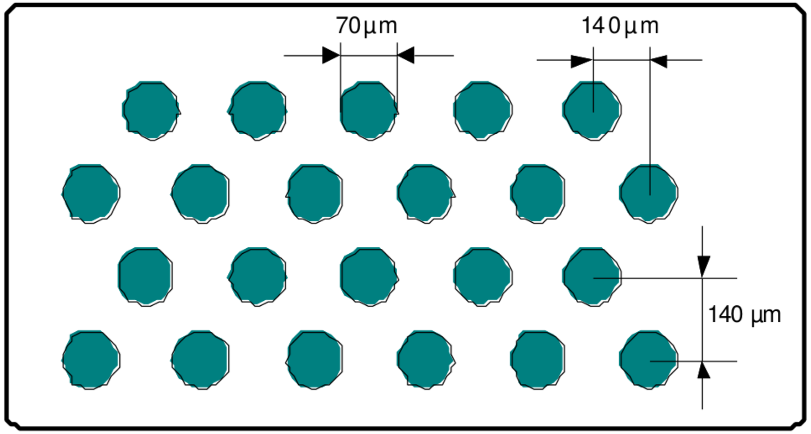
1. **CLAS12 @ JLAB:** the upgrade of the muon spectrometer
2. **X17 @ n_TOF EAR2**: for the amplification stage of a TPC dedicated to the detection of the X17 boson
3. **TACTIC @ YORK Univ.:** radial TPC for detection of nuclear reactions with astrophysical significnace
4. **Muon collider:** hadron calorimeter
5. **CMD3:** uRWELL Disk for the upgrade of the tracking system
6. **URANIA-V**: a project funded by CSN5 for neutron detection, an ideal spin-off of the EU-founded ATTRACT-URANIA
7. **UKRI:** neutron detection with pressurized ^{3}He-based gas mixtures

The state of art of the µ-RWELL technology by M. Poli Lener
for G. Bencivenni, R. De Oliveira, G. Felici, M. Gatta, M. Giovanetti, G. Morello at MPGD2022

The root of µ-RWell: GEM

F.Sauli, Nucl. Instr. and Meth. A386 (1997) 531

From Archana SHARMA



GEM top view

The root of µ-RWell: GEM

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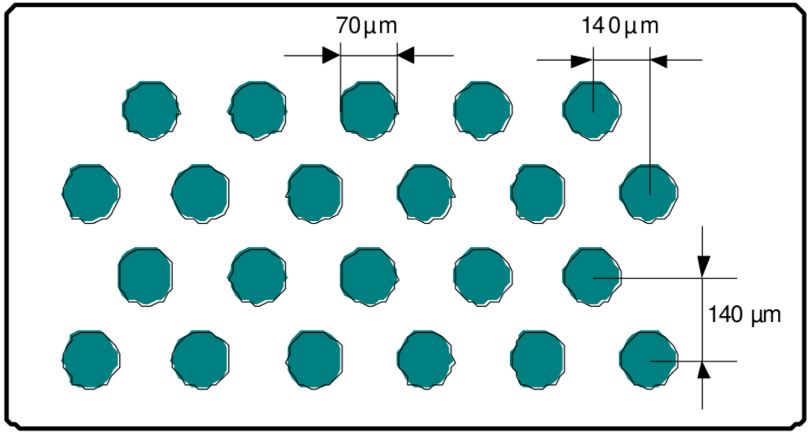

GEM top view

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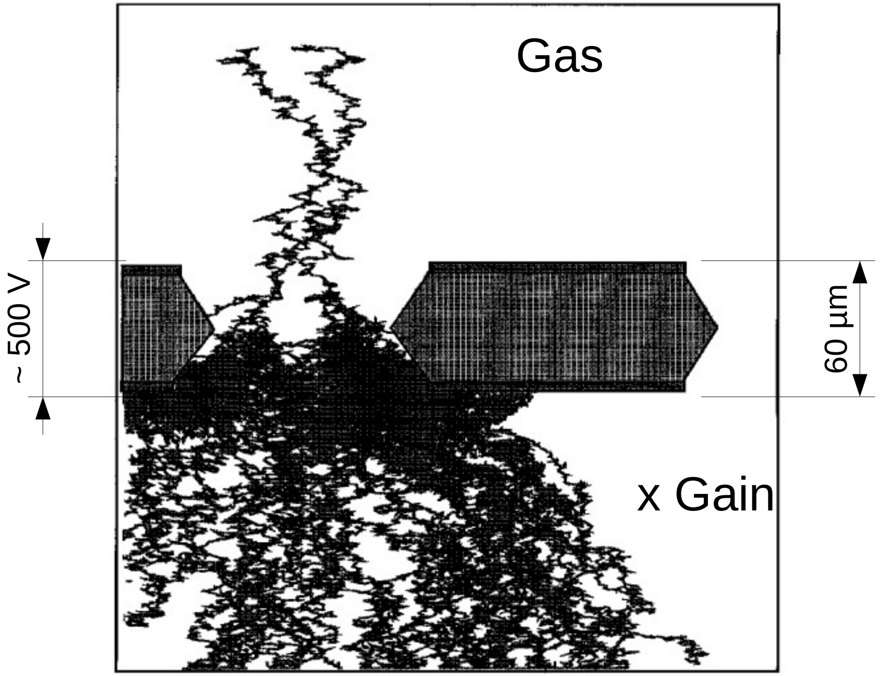
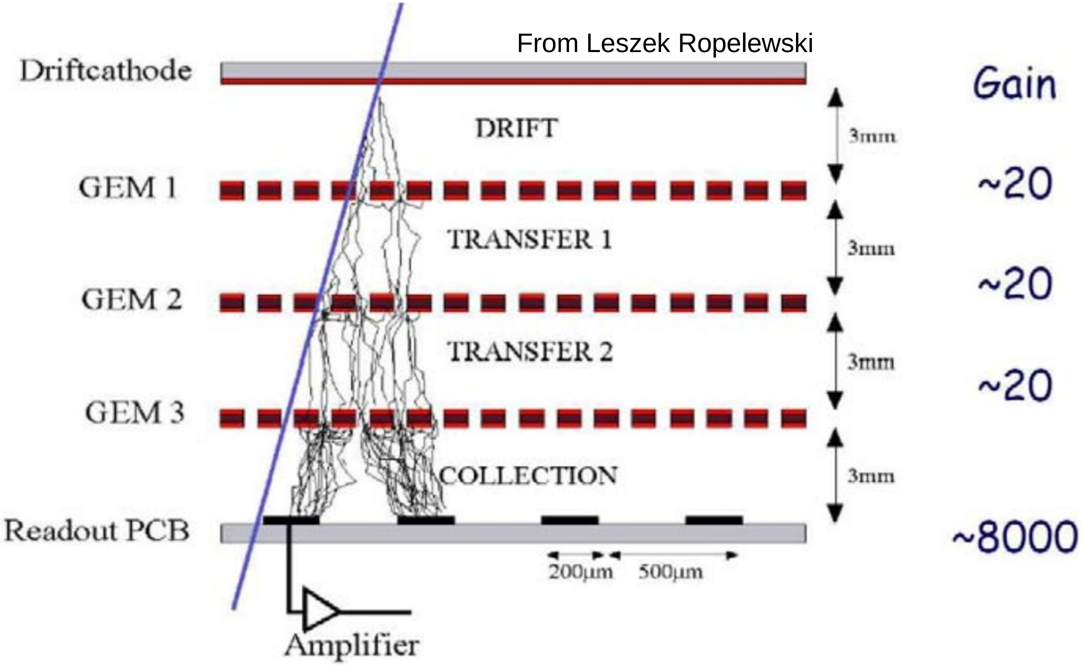


GEM side view with avalanche

500V necessary to reach gain of 300, breaks above 550V.

The root of µ-RWell: limitations of GEM

Increase achievable gain



Currently still R&D on the topic and used in numerous experiments but...

- Mechanical constraints due to the three layers
- Non negligeable amount of material
- Spark free but still fragile
- Can we be faster? Can we stand higher fluxes?

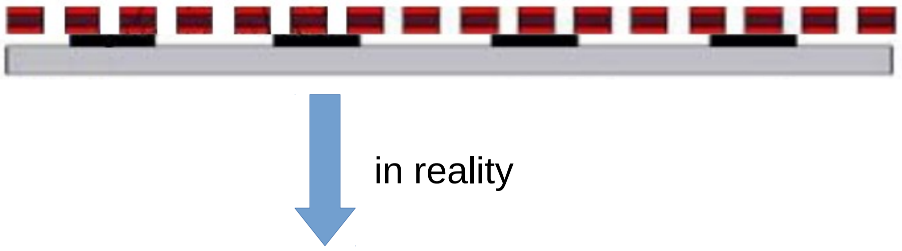
The root of µ-RWell: the idea

GEM foil directly in/on the PCB

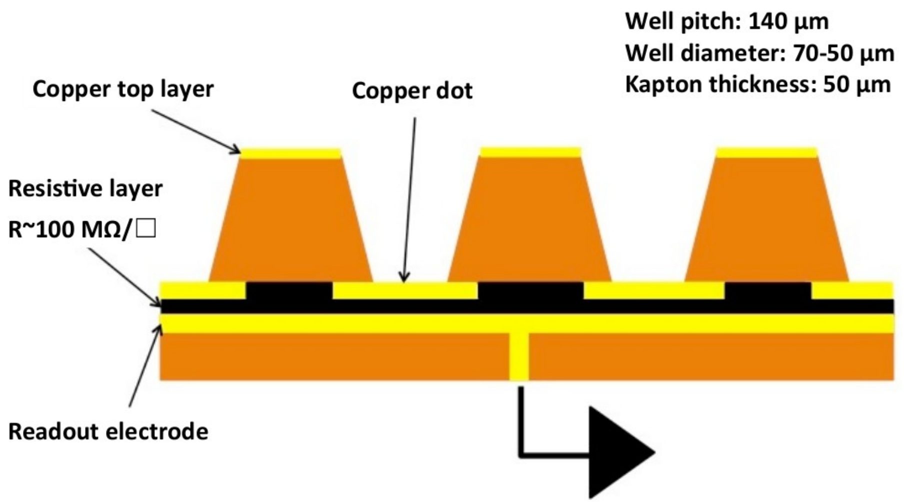
Why? First obvious points:
- it's compact
- no need for complicated mounting procedures

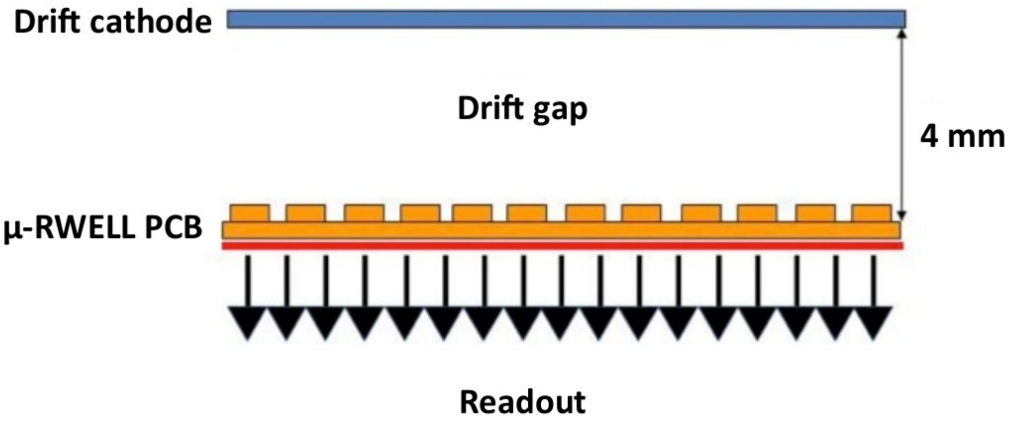
The root of µ-RWell: the idea

GEM foil directly in/on the PCB



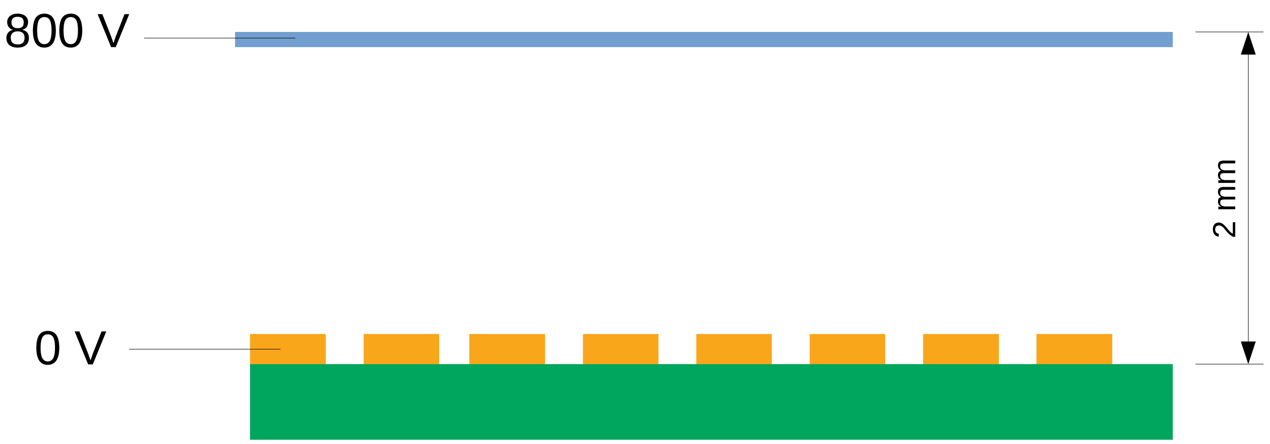
Why? First obvious points:
- it's compact
- no need for complicated mounting procedures
- spark resistant



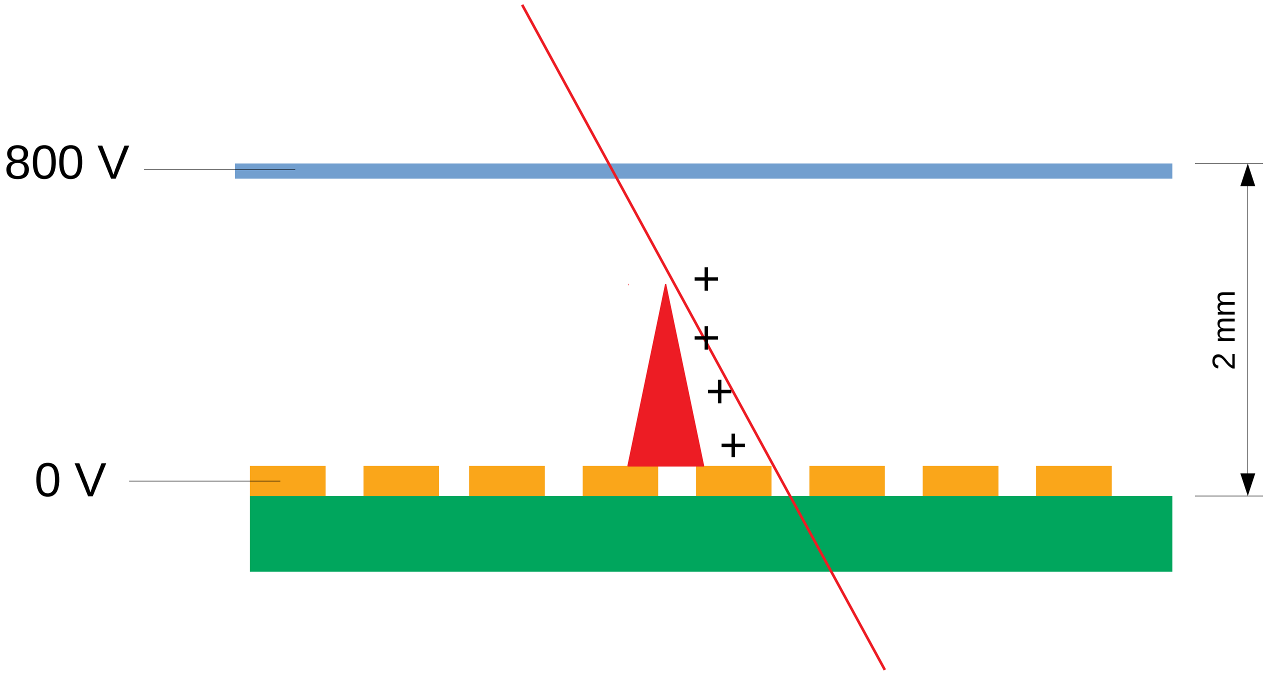


First publication in 2015: G. Bencivenni *et al.* JINST 10 P02008

About the resistive layer



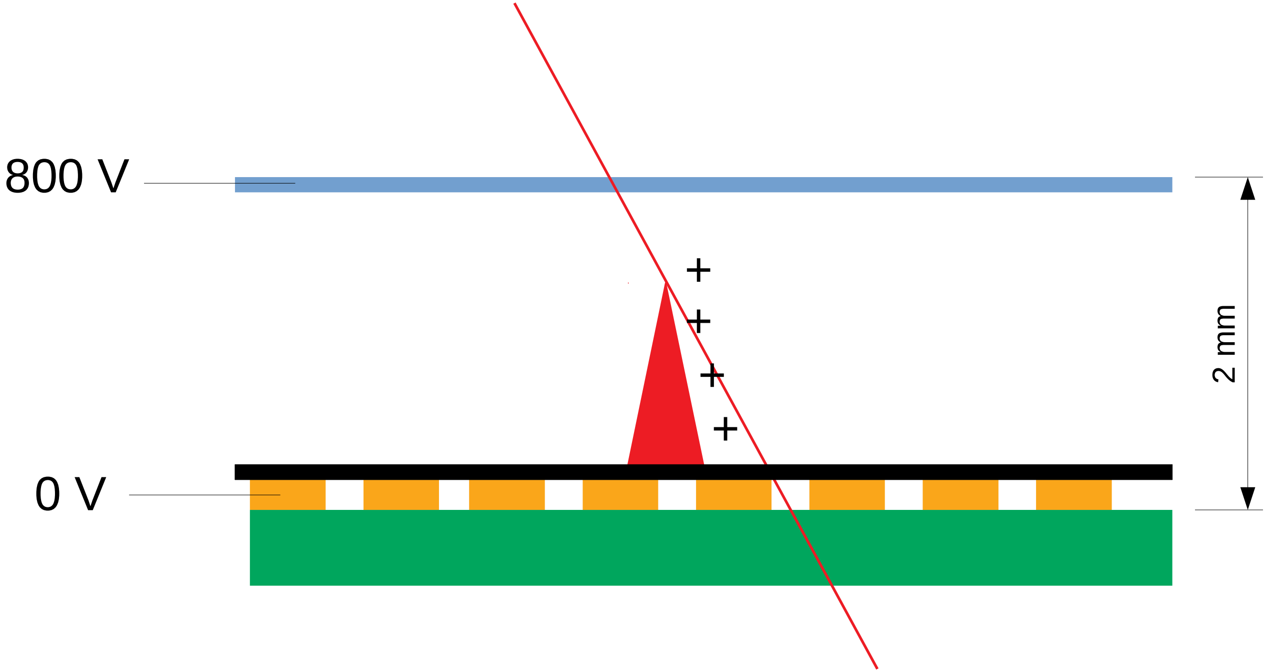
About the resistive layer



If the number of electrons produced is too large (Rather limit): a spark occurs

The spark stops when the strips and the anode have reached a value close enough to stop the spark

About the resistive layer



Same phenomena

If the number of electrons produced is too large (Rather limit): a spark occurs

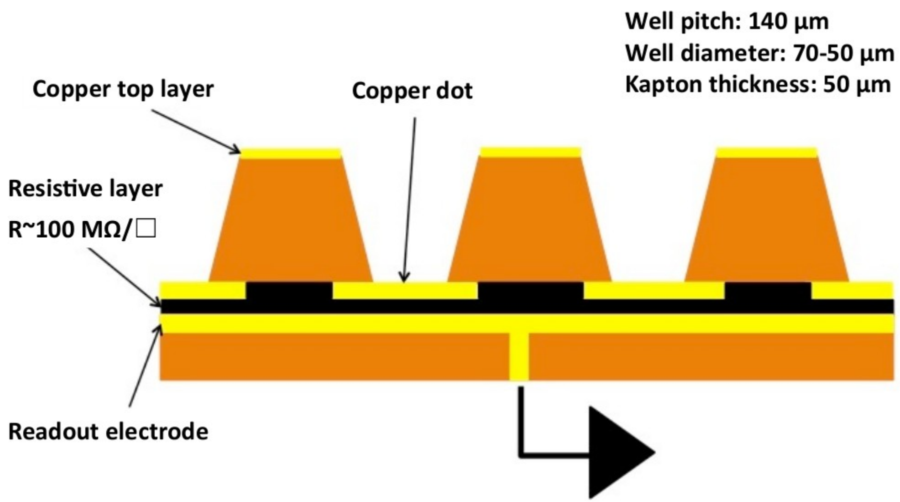
The spark stops when the strips and the anode have reached a value close enough to stop the spark

But due to the resistivity of the resistive layer the phenomenon is local and instantaneous. The spark occurs but goes unoticed

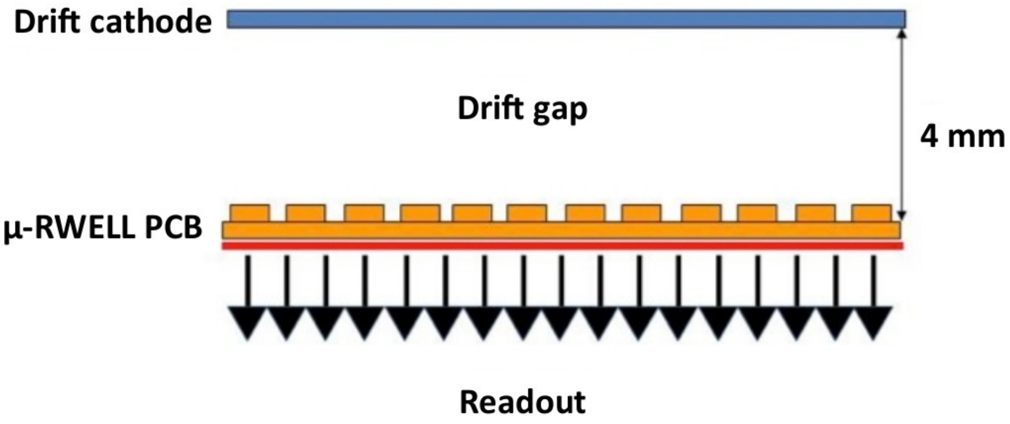
The root of µ-RWell: the idea

GEM foil directly in/on the PCB

in reality



Why? First obvious points:
- it's compact
- no need for complicated mounting procedures
- **spark resistant**



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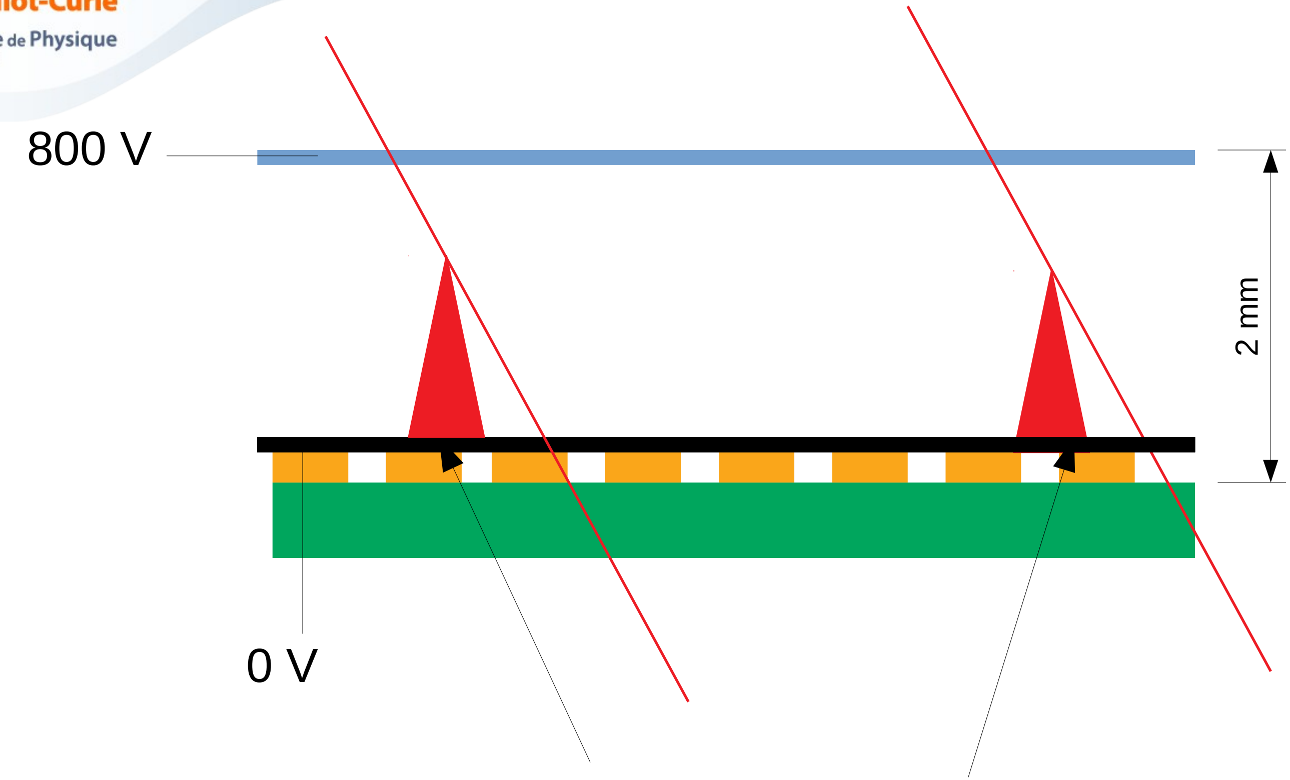
μ-Rwell and high rate



Avalanche induces current on the pads, here resistive hence the potential changes.

This induces a non uniform response of the detector

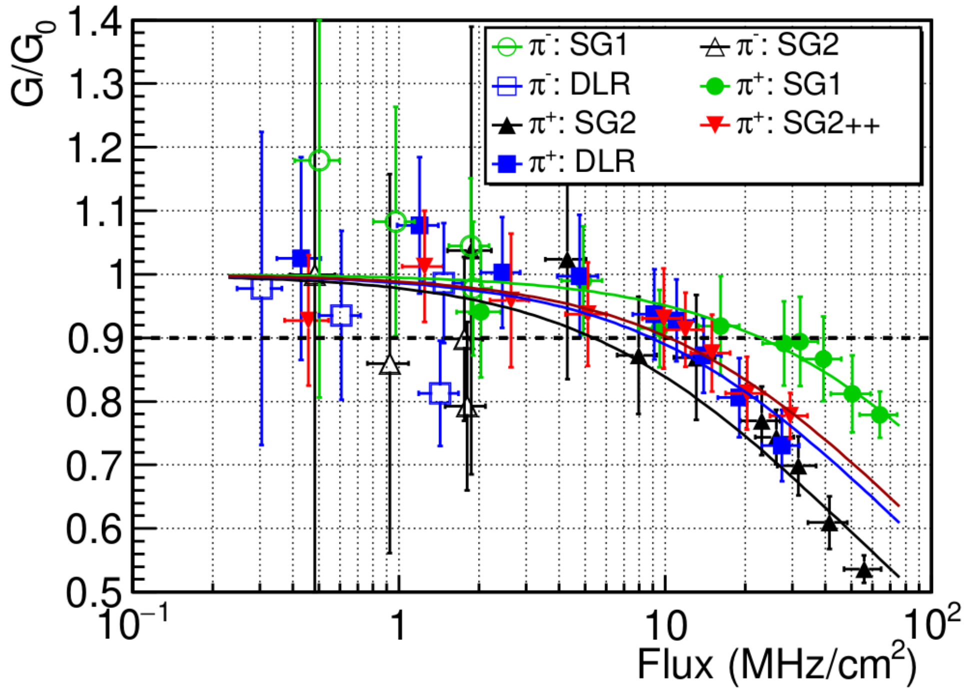
Different path to ground,hence different resistive layer potential

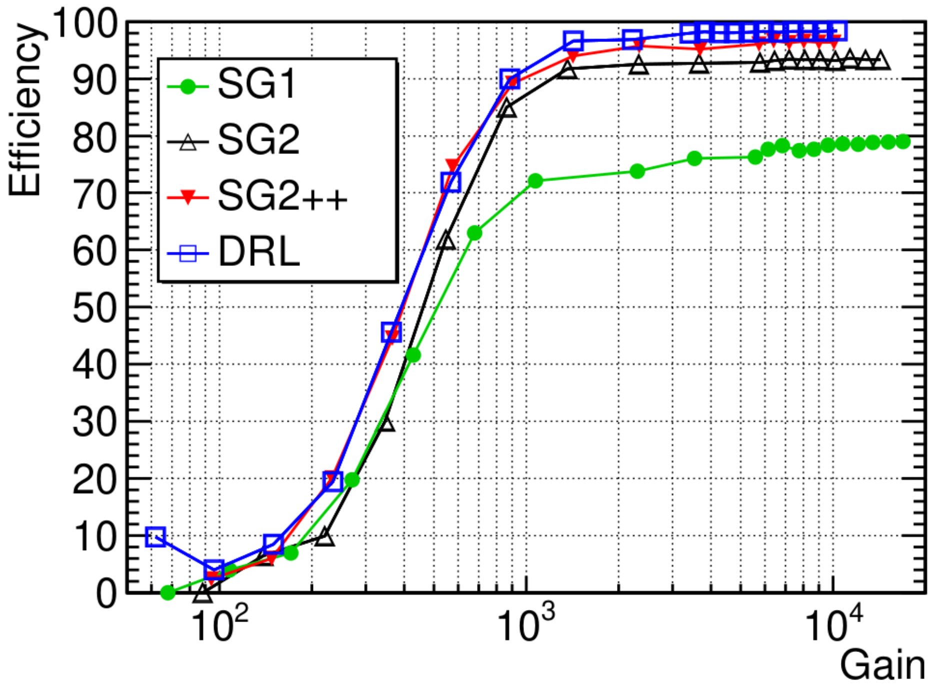
µ-Rwell and high rate

High density of grounding is necessary

From G. Bencivenni et al
2020 JINST 15 C09034

In Ar/CO_2/CF_4 (45/15/40)





Compatible with HL-LHC and FCC-ee rate

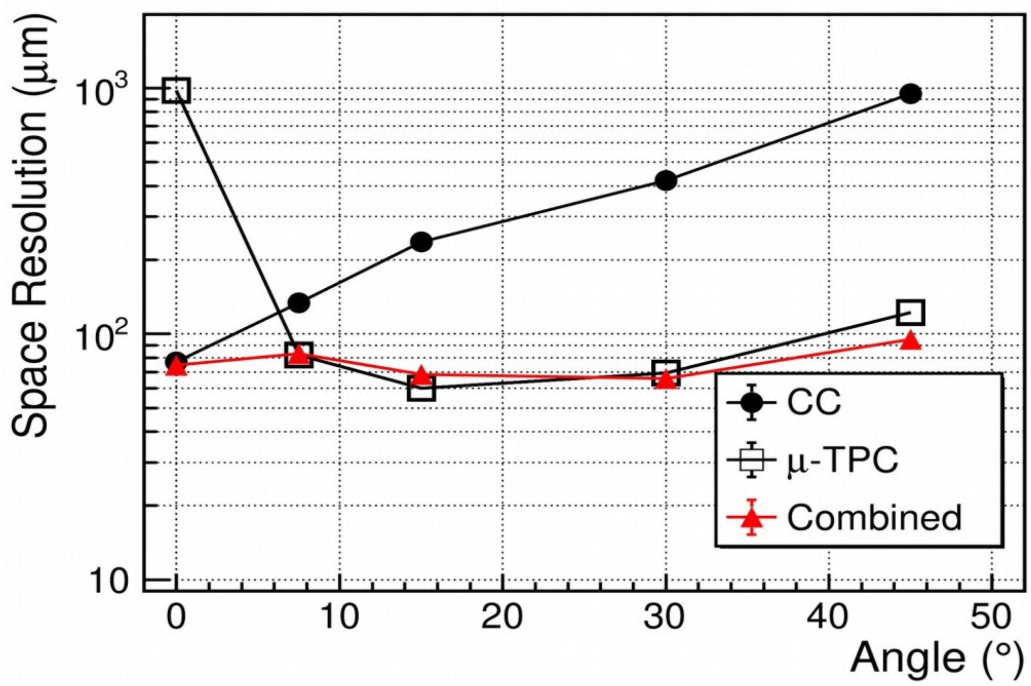
μ-RWell: spatial resolution

150 GeV/c muon beam

400 μm strip pitch

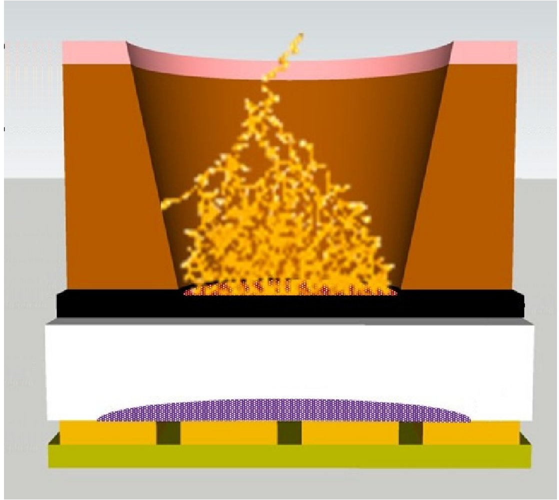
Gain = 5 000

$Ar/CO_2/CF_4$ (45/15/40) gas mixture



μ-RWell: done and future

Can stand up to ~4-5 MHz/cm^2
Can reach ~100 µm spatial resolution



Aspects not presented:
- transfer to the industry started from the begining of the R&D
- not yet square meter detector
- eco-gas mixtures R&D
- stability and aging R&D (aging is good so far, no difference for 100 mC/cm^2,10 times more is necessary for LHCb phase 2)