DE LA RECHERCHE À L'INDUSTRIE

CEA-Saclay group

F.Bossu for DPhN and DEDIP

EIC YR – Tracking WG
20 Feb 2020

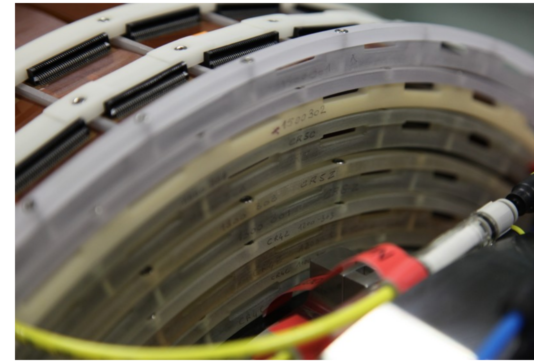
CEA-Saclay group

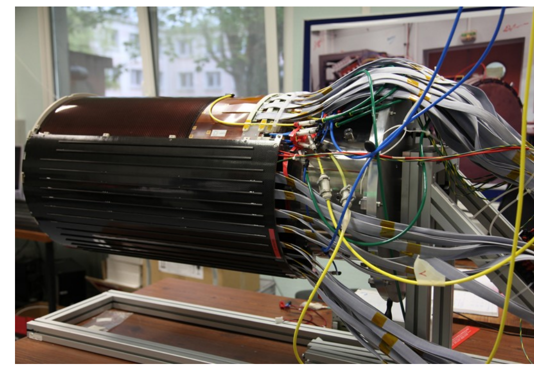
- Long experience in gaseous detectors, in particular Micromegas based detectors
- Consolidated experience in working on large projects
- Development of ASICS for MPGD read out
- Lively R&D in many areas of MPGDs:
- laser-etching of readout patterns (LDRD),
- very-low ion backflow for TPC readout
- no amplification readout electronics
- picosecond precision with Micromegas (PICOSEC)
- design and assembly of fast and low-X/X0 tracking prototypes for an EIC (eRD3)
- interest in streaming read-out

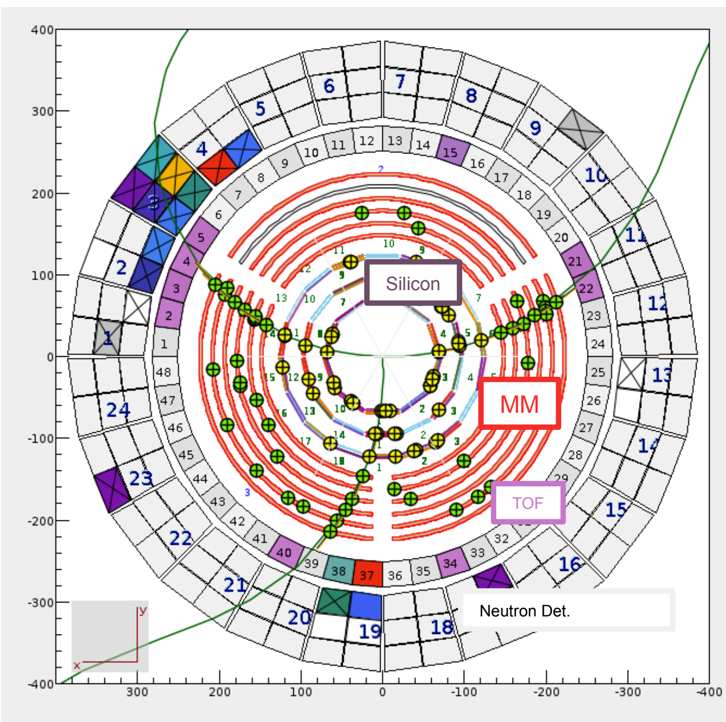
- Lively interactions with colleagues in physics working group for the YR

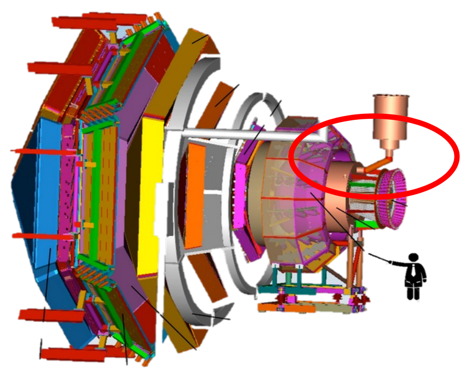
CLAS 12 Micromegas Vertex Tracker

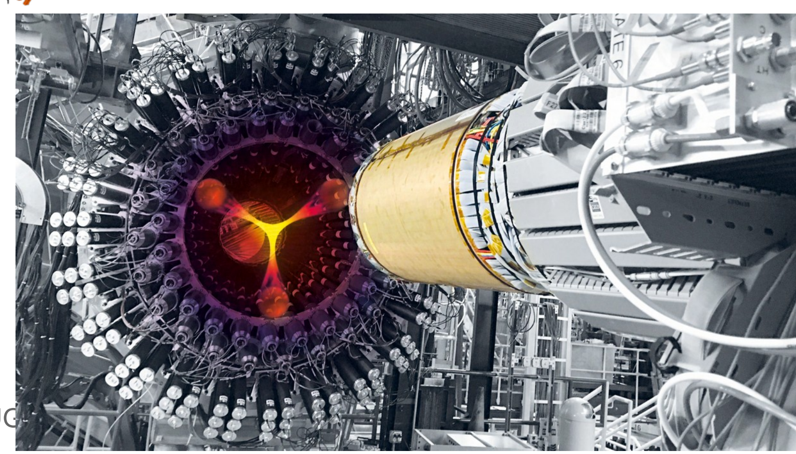
- 4 m² of curved Micromegas detectors
- DREAM based Front-End Electronics ~ 20k ch.
- Low momentum particles => Light Detectors ~0.5% of X0
- Limited space of ~10 cm for 6 layers
- High magnetic field (5T)
- 6 Layers with different R (18 detectors total)
- Up to 30 MHz of particle rate





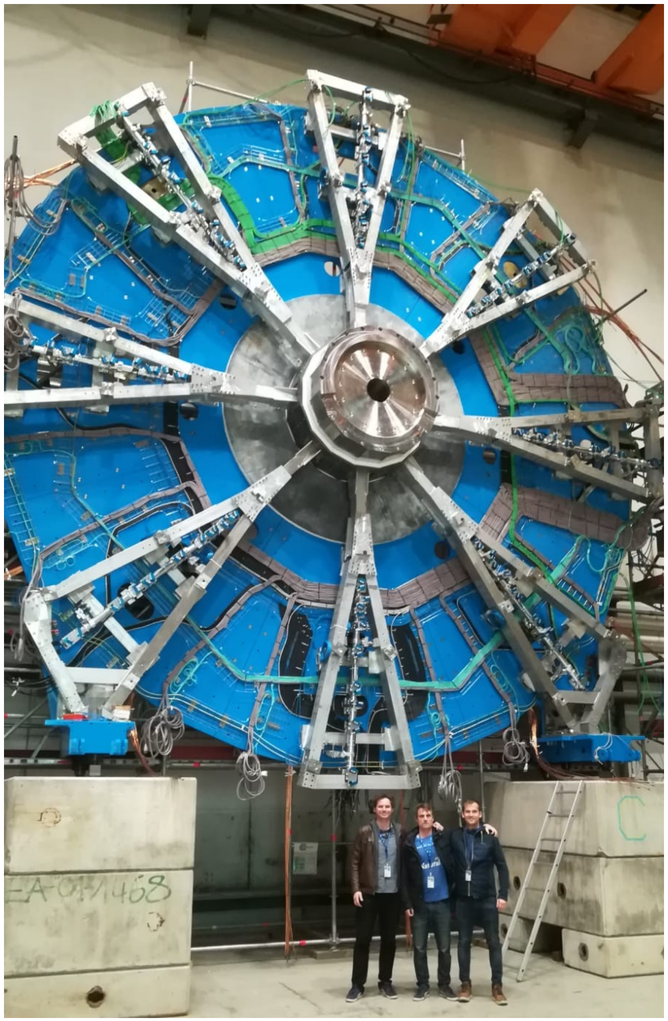


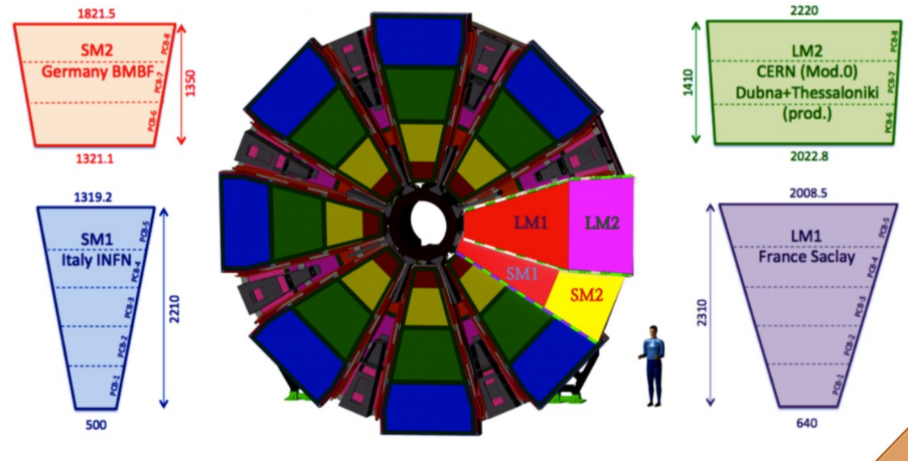




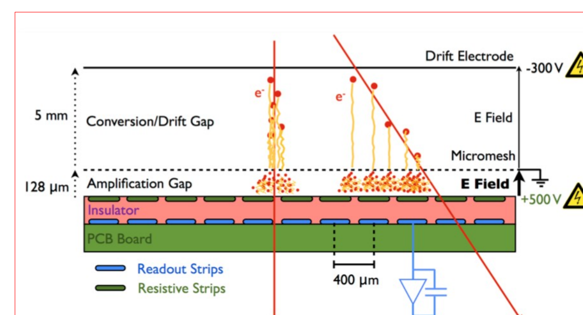
Large planar detectors

ATLAS NEW SMALL WHEEL

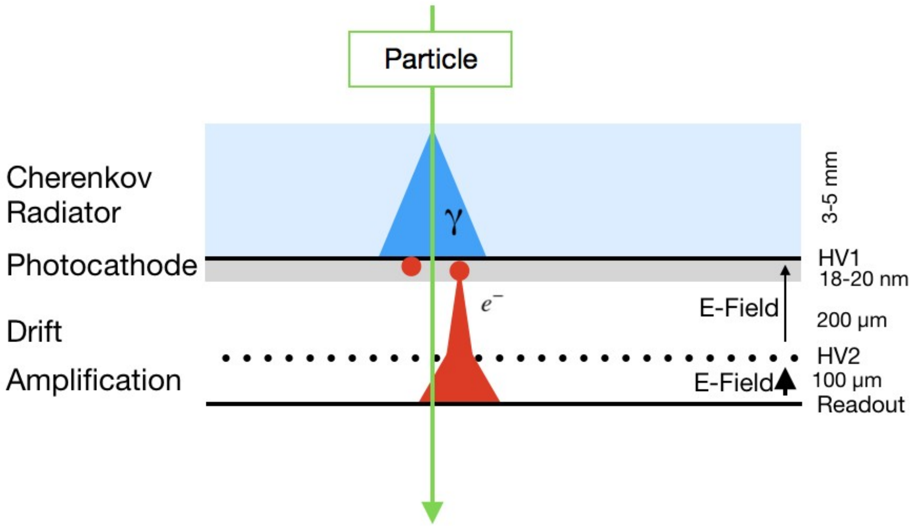


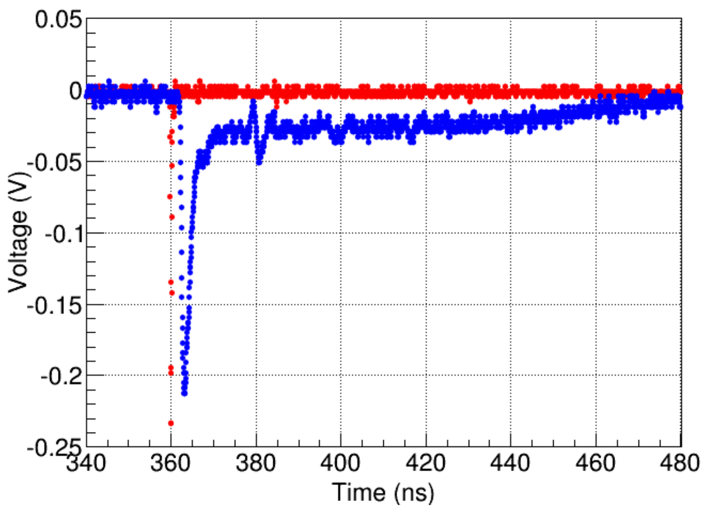


- 2 Industrial PCB production (ELVIA, ELTOS)
- 1200m2 of resistive Micromegas
- 100um mechanical precision
- Max rate 15kHz/cm^2
- 2M channels



The “PICOSEC” Micromegas concept





- A particle produces Cerenkov light.
- Photons produce electrons in the photocathode.
- Electrons are amplified by a two stage Micromegas detector.
- Two signal components:
  - Fast: ***electron peak*** (~1 ns). -> Timing features.
  - Slow: ***ion tail*** (~100 ns).

Small drift gap (200 nm):

- Pre-amplification possible
- Limited direct ionization
- Reduced diffusion impact

Cerenkov radiator:

- Photoelectrons emitted simultaneously by the photocathode (fixed distance from the mesh)

Aiming at:

- **single photoelectron time jitter ~100 ps**
- **produce sufficient photoelectrons to reach timing response ~20 ps.**

https://doi.org/10.1088%2F1742-6596%2F1312%2F1%2F012012

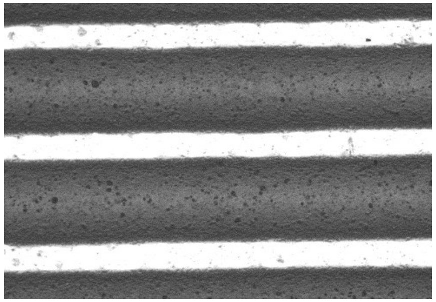
MPGD WORKSHOP

120 m² of clean room for micromegas bulk and resistive layer manufacturing.

Bulk process: addition of a mesh on PCB by photolithography
- Maximum detector seize: 600 x 700 mm².
- Amplification gap from 50 to 292 µm
- Mesh woven (18 µm wires) or thin mesh (down to 5 µm)
- PCB with strip, XY strip, pixel,…
- Production : ~ 150 bulk in 2019
- R&D : thins mesh, curved bulk, segmented mesh, double mesh….


Double face micromegas

Resistive screen printing on various surface
- Maximum seize: 600 x 600 mm²
- Resistive value: from 10 KOhm/sq, to 10 Gohm/sq
- Possibility of neutral on conductive paste
- Substrate: Kapton, glass, FR4
- Production: ~ 100 resistive substrate in 2019
- R&D : mixture for ad hoc resistive value, segmented resistive,…


Resist strip of 500 µm


Bulk lab

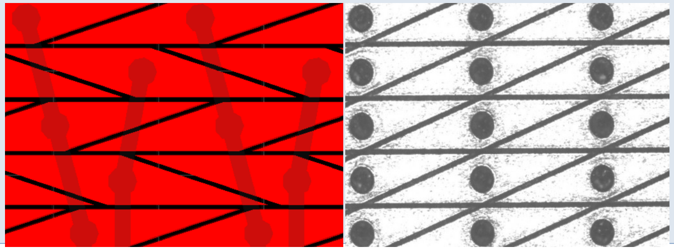

Resist lab

contact stephan.aune@cea.fr

2D READOUT AND LOW-IBF

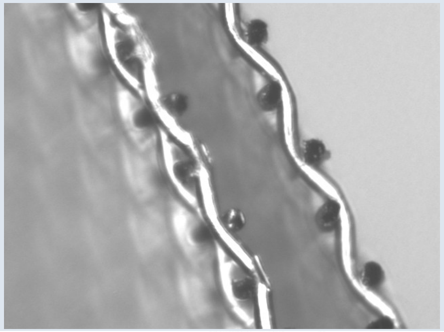
ZigZag 2D read out

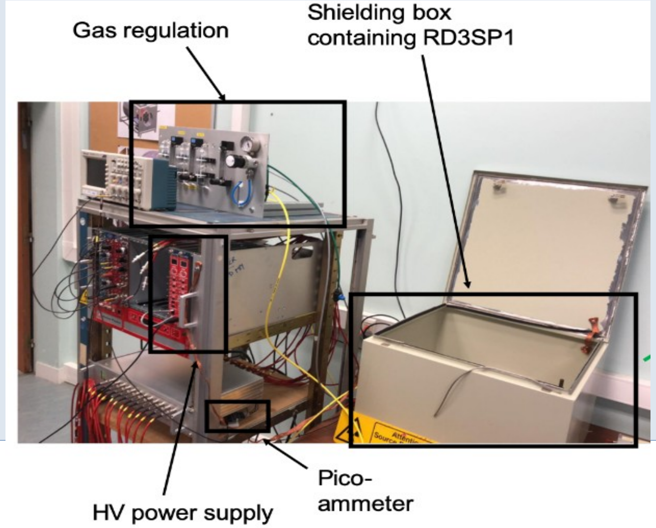
- R&D on laser etching for read out of MPGD detector
- 1D ZigZag: better then 100um res with 2mm strips
- MM, GEM and uRWELL read by the DREAM electronics
- 2D read-out with better than 200um resolution
- Development within an LDRD
- M. Revolle's PhD subject



Low-IBF for TPC

- Micromegas based solutions for
- low-IBF read-out planes for TPC
- A. Glaenzer's PhD subject

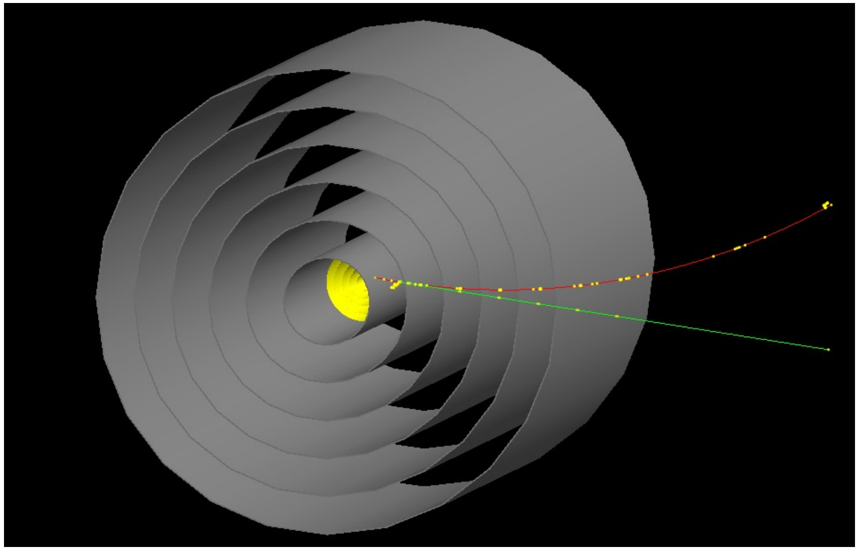




CEA-SACLAY GROUP CONTRIBUTIONS

- **Simulations**

- Started implementation of an ideal barrel detector within Fun4All
- Work done by Q.Huang
- A second post-doc will start in summer to work mainly on tracking detector optimization for EIC
- Several colleagues are participating to the physics working groups (Exclusive processes and Charm/Jets)



Questions

- Common simulation framework within the WG?
- Should we agree on some specs for the magnets, the space, the event rate?
- Background estimates are wellcome

- **Technology reviews**

- Ongoing R&Ds can be evaluated in the context of the YR
- Particular care will be needed in evaluating the scalability from prototype to full size detectors