Resistive MPGD Calorimeter with timing measurement

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Resistive MPGD Calorimeter

- CALICE collaboration has already proposed **gaseous detectors** and in particular **resistive Micromegas** for **sampling hadronic calorimeter (HCAL)**:
  - calice semi-digital HCAL (SDHCAL)prototype equipped with 44 RPC and 4 Micromegas layers [1];
- effort continued within **RD-51 SCREAM project** where **Micromegas** and **RP-WELL** were tested in a small SDHCAL prototype [2].

Why MPGD-base HCAL?

- Radiation hardness,
- fine granularity,
- rate capability O(MHz/cm2)
- good space (<100 um) resolution,
- response uniformity,
- cheap for large area instrumentation.

What to add? Timing information:

- to identify thermalized neutrons
- to separate close-by showers
- to clean energy deposits derived from beam-induced background, at alternative future colliders such as muon colliders

Resistive MPGD Calorimeter

Development of Resistive MPGD Calorimeter with timing measurement (2021)

RD51 Institutes:

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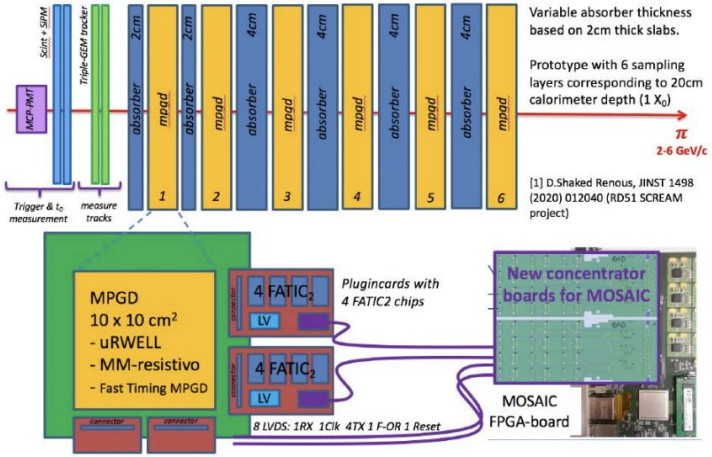
\+ Weizmann Institutes

Design of MPGD-based HCAL cell



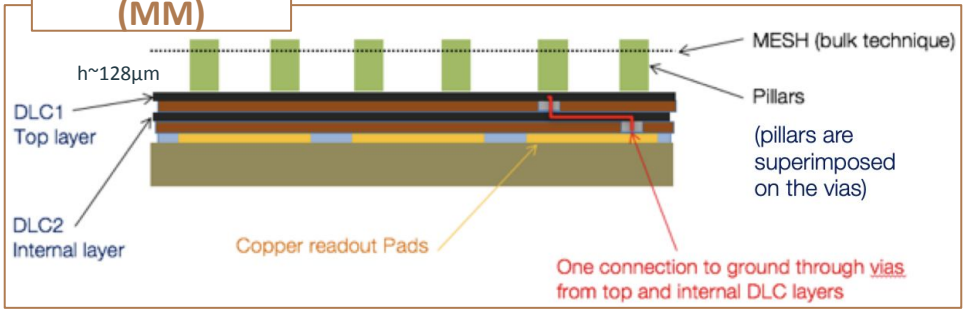
started a common project under the RD51 hat

Different technologies

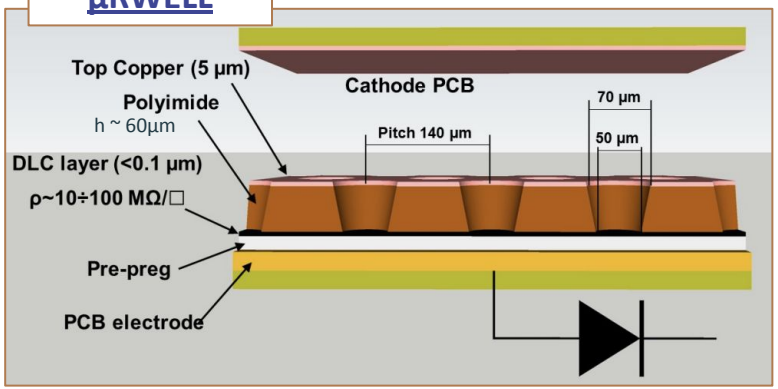
20x20cm2 MPGDs produced:

- 7 µRWELL
- 4 MM
- 1 RPWELL

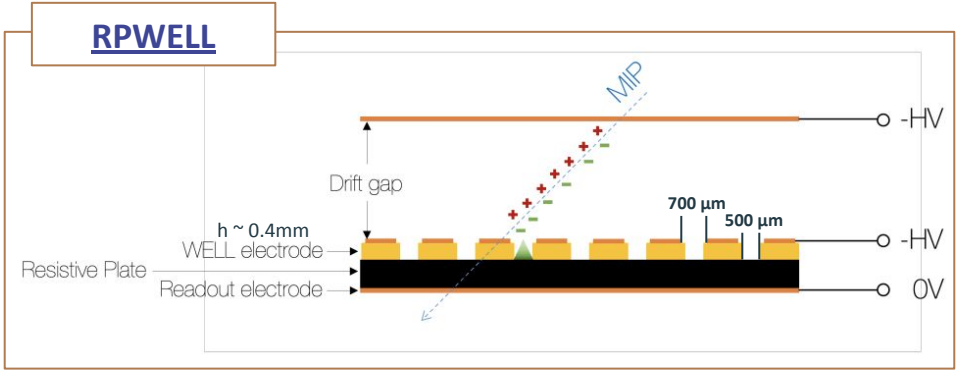
Micromegas (MM)



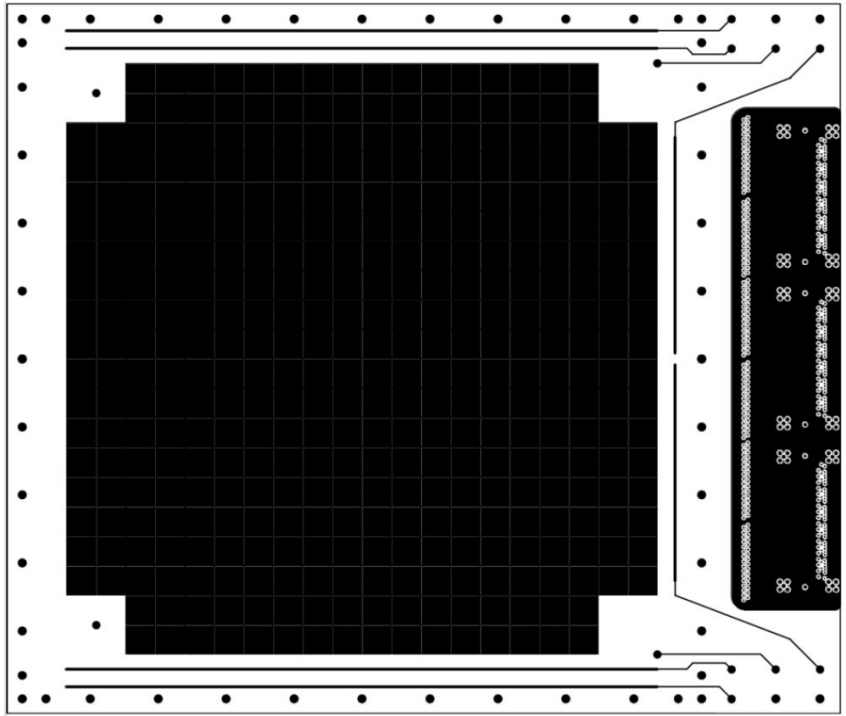
µRWELL

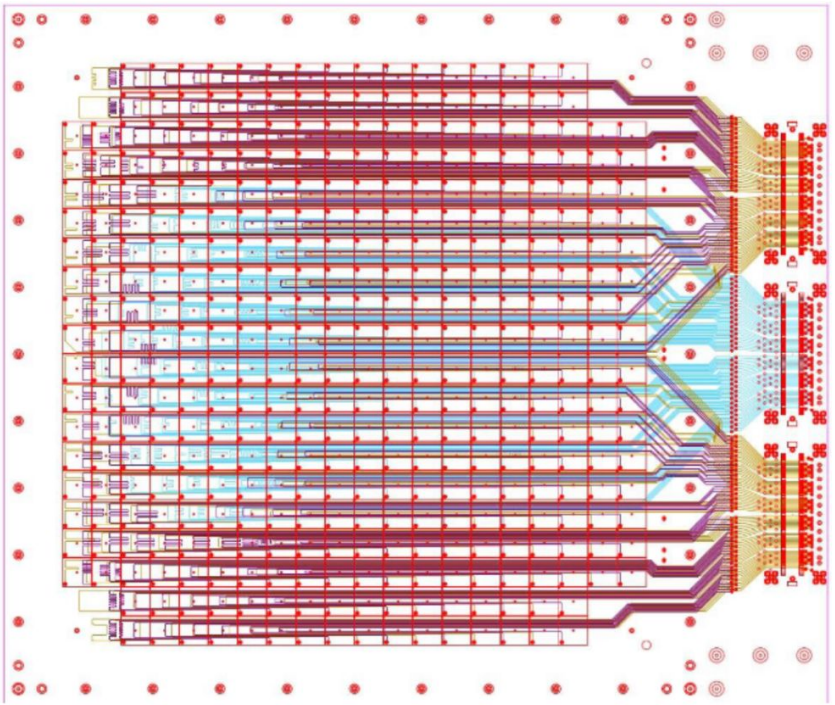


RPWELL



but same readout





MPGD-HCAL setup

- **2 supporting structures:**
  - “calo structure” hosting up to 12 MPGD chambers where we can easily integrated iron slabs:
    - to be upgraded for hosting 50x50cm2 chambers
  - “tracker structure” (60x60x120cm3):
    - 2 scintillators
    - 2 Tmm (X&Y readout)
    - 1 GEM (X&Y readout)

- **Electronics:**
  - APV25
  - FEC+ADC
  - preliminary measurements with µRWELL/RPWELL coupled to VMM3a done
- **Gas:**
  - (Ar:CO2:Iso): (93:5:2) for MM & RPWELL
  - (Ar:CO2:CF4): (45:15:40) for µRWELL

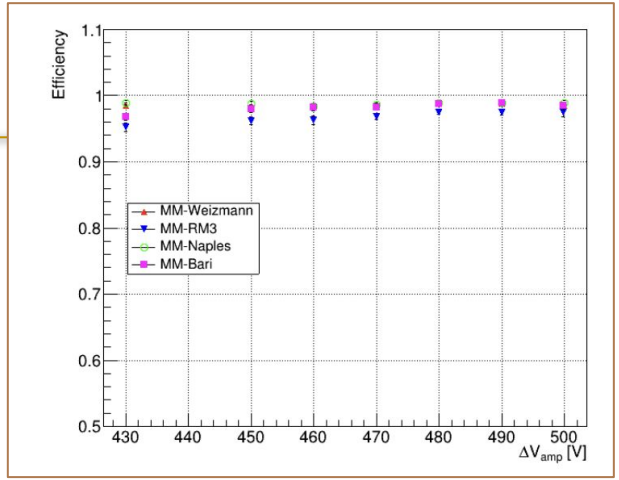
MPGD-HCAL measurements

July 2023, previous test beam campaign at SPS with O(100 GeV) muon beam (a big thank for the help received by RD51 in debugging our system):

- efficiency Vs HV⟶ all detectors show an efficiency higher than 90%
- gain uniformity ⟶ observed some disuniformity on µRWELL that must be further investigated

Targets for the new test beam campaign (with a preference for summer period):

- full efficiency Vs HV curve
- gain uniformity (X&Y scan)
- timing measurement
- continue tests with VMM electronics (if possible with the help of experts)



Beam:

- muon beam of O(100 GeV)
- rate of 10/100 kHz/cm2
- 2 weeks

Additional requests:

- desy table for *calo structure*
- manual table for *tracker structure*