Single-stage THGEM detectors in SPS/H4 test beam

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Project supported by RD51 collaboration

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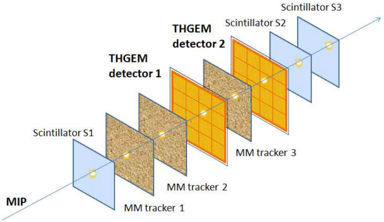
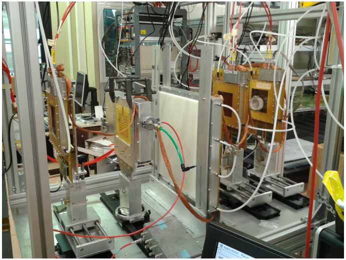
Test beam setup

Similar to the setup in 2012

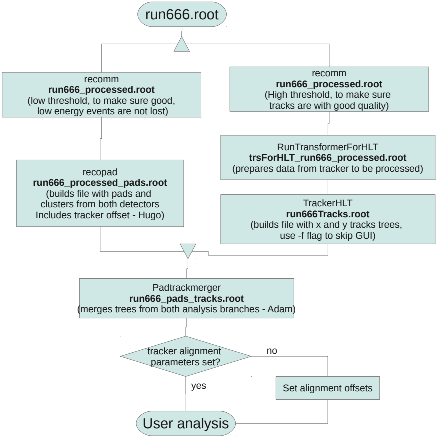
- RD51 mm telescope
  - 3 scintillators (covering $60 \times 60\mathrm{mm}^2$) for triggering (failure when magnetic field is on)
  - 3 Micromegas for precision tracking
- Two THGEM chambers
- Common DCS (HV control and monitoring)

Test beam setup





Analysis suite

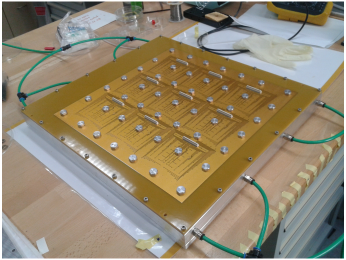


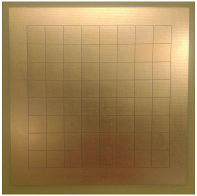
- mmDAQ: combined for the tested detectors and the tracker
- recom: initial reprocessing of row data - configuration optimized for each detector separately
  - High threshold for tracker → for high track quality
  - Detector threshold to optimize efficiency and multiplicity
- recopad: custom software → fix alignment and pad

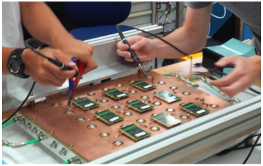
Readout

All the detectors are readout by the SRS with APV25 chips.

1 cm^2 squared pads.

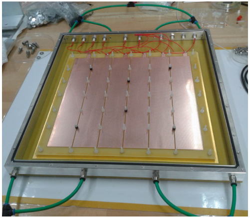


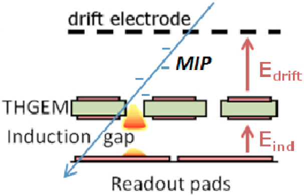




http://iopscience.iop.org/1748-0221/8/03/C03015
http://www.sciencedirect.com/science/article/pii/S0168900201005897

1mm induction gap: setup





The charge is multiplied both in the THGEM hole and in the induction gap (G_{ind} ∼10).

- 1 mm induction gap;
- Induction field 3 kV/cm;
- Gas: $Ne/CH_4(95/5)$;

1mm induction gap: setup

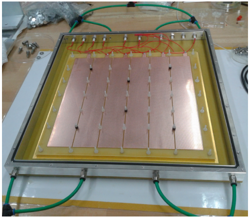
Single stage 300×300 mm^2 THGEM detector.

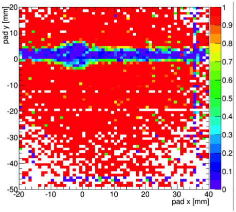
Detector properties

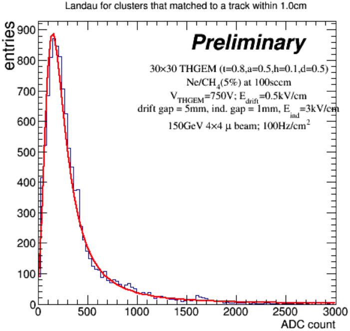
- 6 THGEM segments 50×300 mm^2 independently biased;
- t=400 μm, h=100 μm, d=500 μm, a=1 mm;
- Drift gap 0.5 cm;
- Drift field 0.5 kV/cm;
- Gas: Ne/CH_4(95/5);

(t=thickness, h=rim, d=hole diameter, a=hole pitch)

1mm induction gap: local efficiency







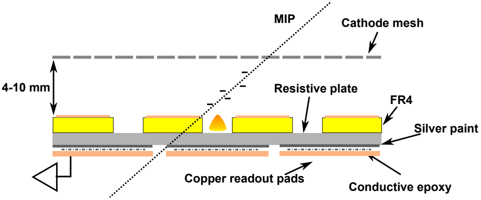
- Efficiency loss due to electrode segmentation
- Efficiency in active area $>95\%$

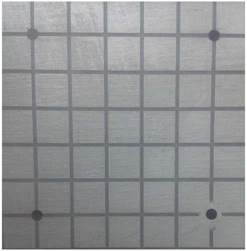
RPWELL: setup

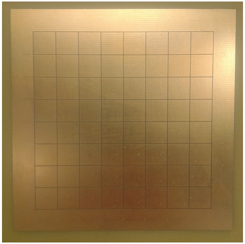
Resistive plate

0.4 mm Semitron ESD225 sheet

- Bulk resistivity: $1.6 \cdot 10^8$ Ωcm;
- Silver paint pads coupled to anode pads.







RPWELL: setup

Single stage 100×100 mm^2 RPWELL detector.

(http://iopscience.iop.org/1748-0221/8/11/P11004)

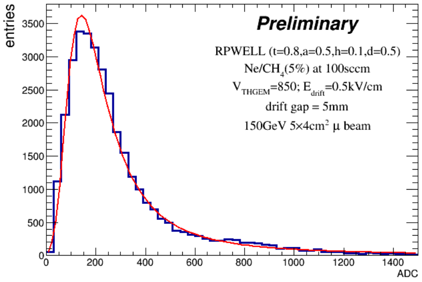
Detector facts

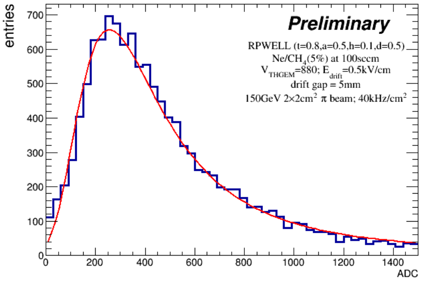
- No electrode segmentation;
- t=800 μm, h=100 μm, d=500 μm, a=1 mm;
- Drift gap 0.5 cm;
- Drift field 0.5 kV/cm;
- Gas: Ne/CH_4(95/5);

(t=thickness, h=rim, d=hole diameter, a=hole pitch)

RPWELL: spectra

Spectra in low rate μ and high rate π beam.





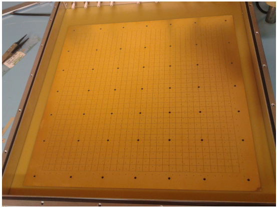
Efficiency $> 98\%$.

No discharges!

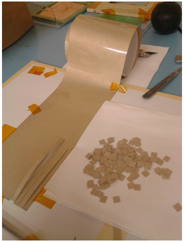
Test beam: what next

- $100 \times 100 mm^2$ RPWELL: reduce drift gap from 5 mm to 3 mm;
- $300 \times 300 mm^2$ RPWELL.
- Try operating RPWELL in Ar/CH_4.

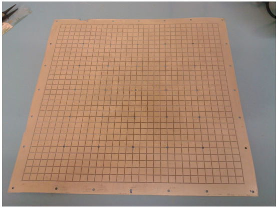
bare anode



conductive tape



semitron sheet



Summary

- Two single-stage THGEM detector operated in Ne/CH_4(5%)
  - $300 \times 300 mm^2$ 1 mm induction gap;
  - $100 \times 100 mm^2$ RPWELL;
- Measured in μ and π beam efficiency, pad multiplicity, discharge probability
  - Depending on the source rate (rate scan);
  - Depending on the detector gain (voltage scan);
  - Depending on the incidence angle (angle scan);
  - Depending on the position across the detector.
- RPWELL: Quiet operation (no discharges) - stands high rates.

All these measurements will be discussed in the WG2 presentation on 11th December.

Many thanks to the RD51 collaboration, particularly to Eraldo Olivieri for the support offered to us before and during the TB.