Measurements during the October test beam with the GEM-TPC and Timepix

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Bundesministerium für Bildung und Forschung

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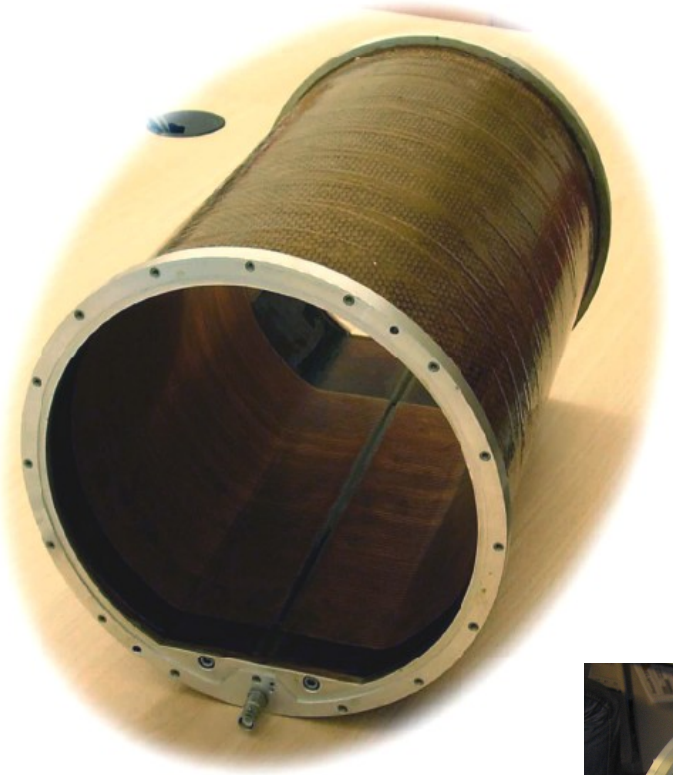
CERN, 24. November 2009

TPC Prototype at Bonn

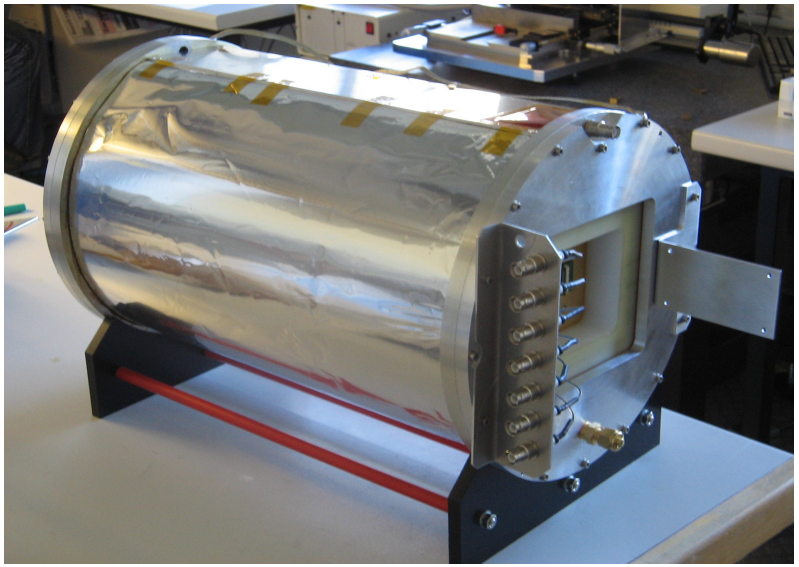


Drift cylinder:

- drift distance: 26 cm
- inner diameter: 23 cm
- material budget: 1 % X_0

Gas amplification:

- 3 GEMs 1mm apart



Currently:

He : CO_2 70:30

E_{drift} : 500 V/cm

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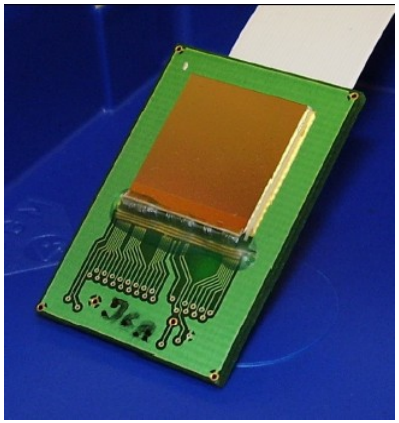
Detector: TPC



256 × 256 pixel

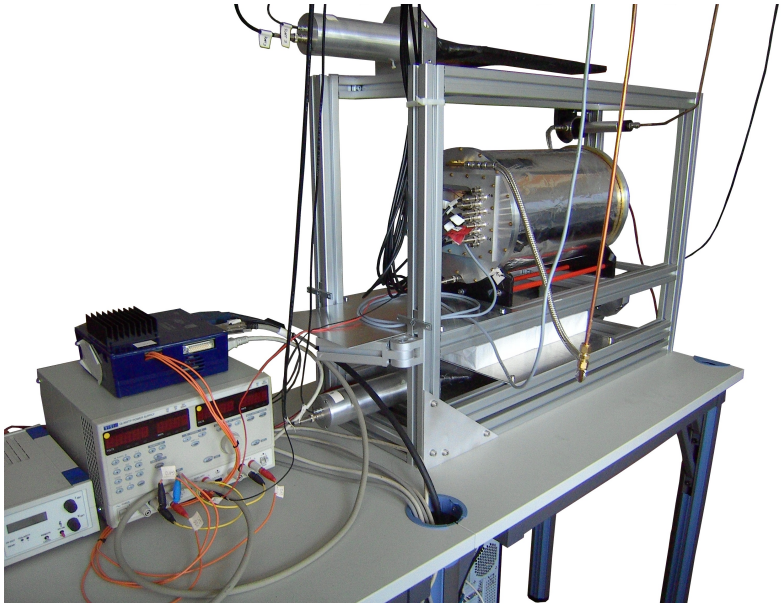
pixel size: 55 × 55 μm²

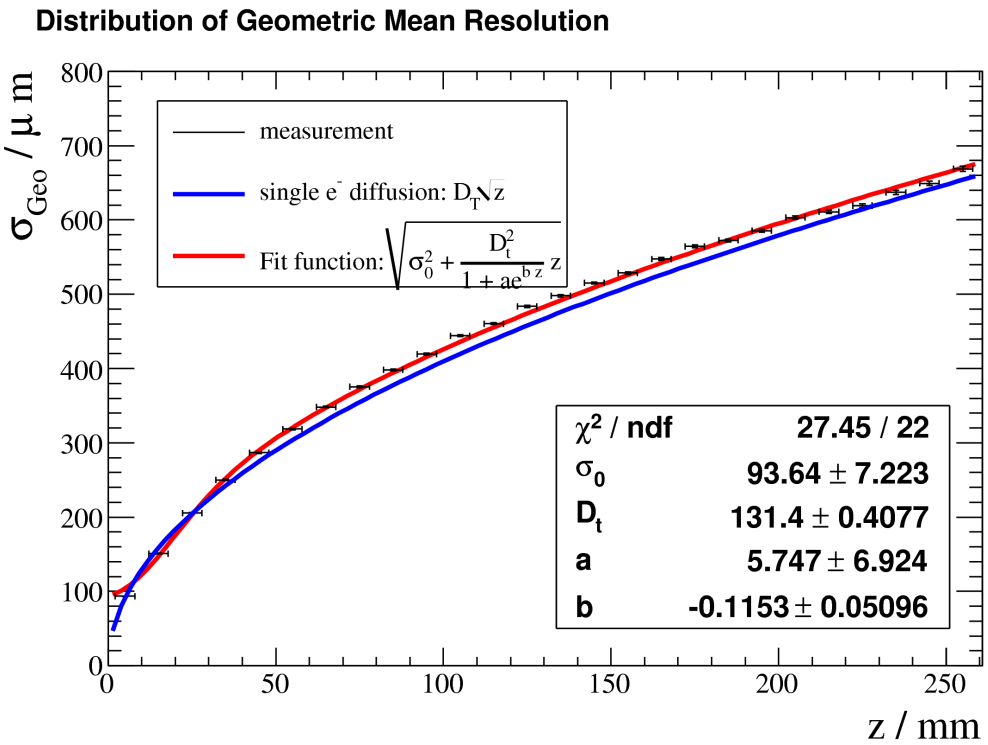
chip dimensions: 1.4 × 1.4 cm²

Operated in checker-board pattern of TOT (charge) and Time

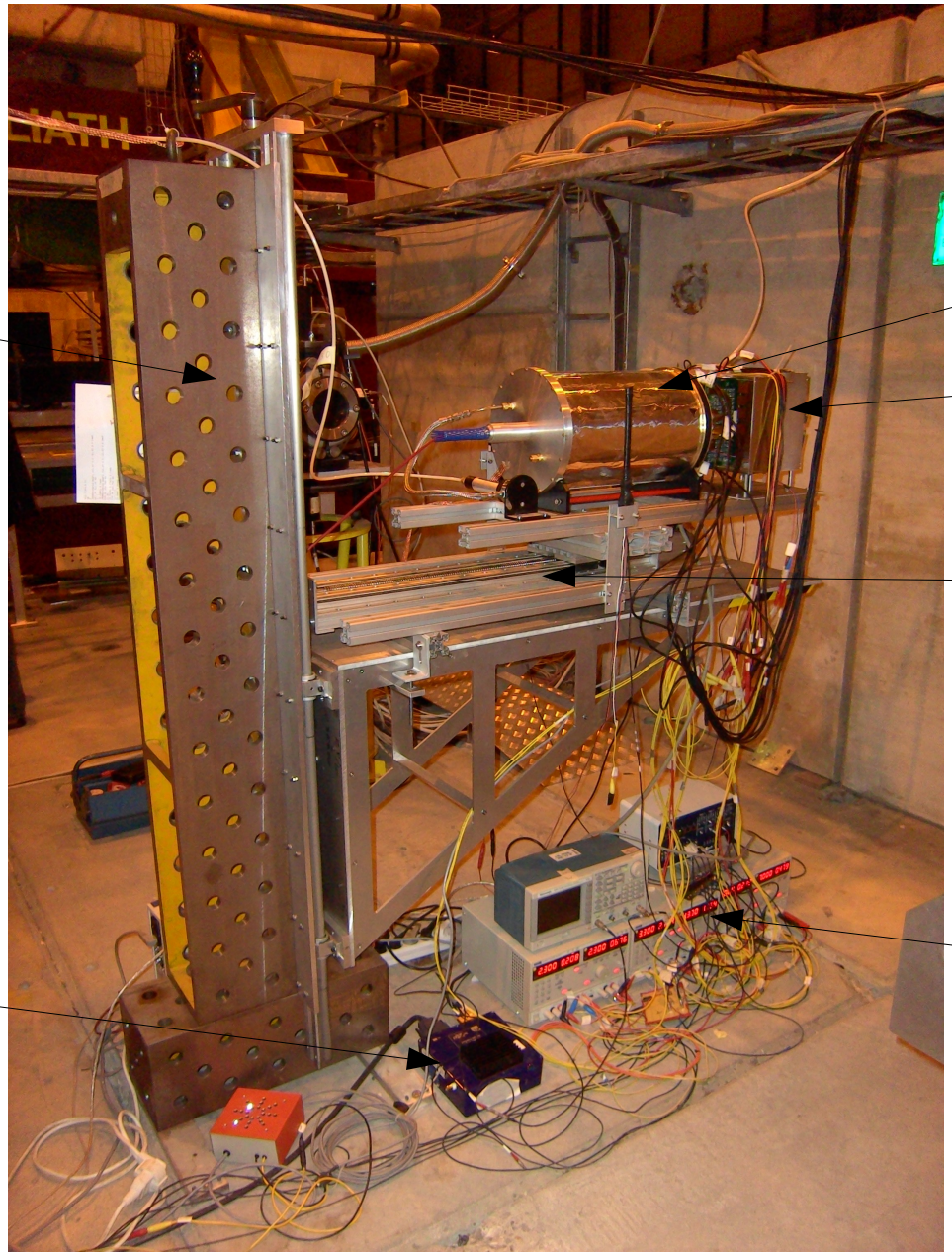
Cosmic ray test stand:

~ 1 month for 80,000 tracks





Setup in the Test Beam Area



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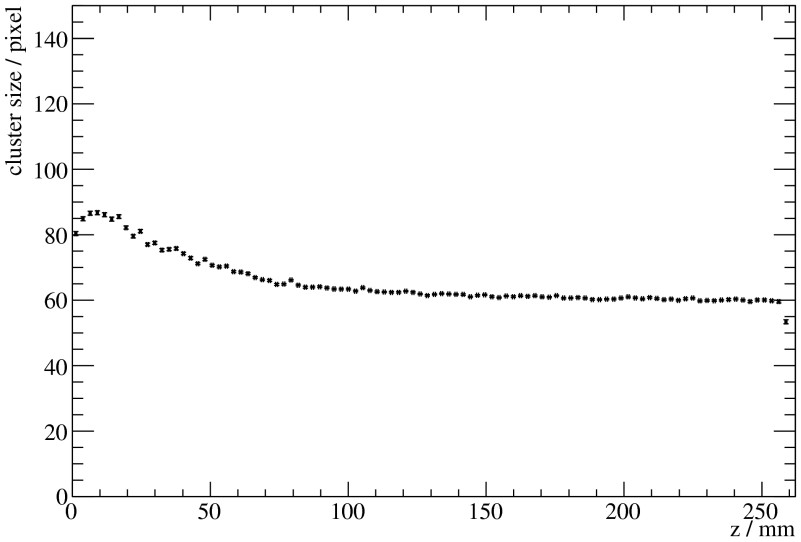
Goal 1 for Test Beam: Larger Pixel Sizes



Charge depositions are spread over ~60 pixels

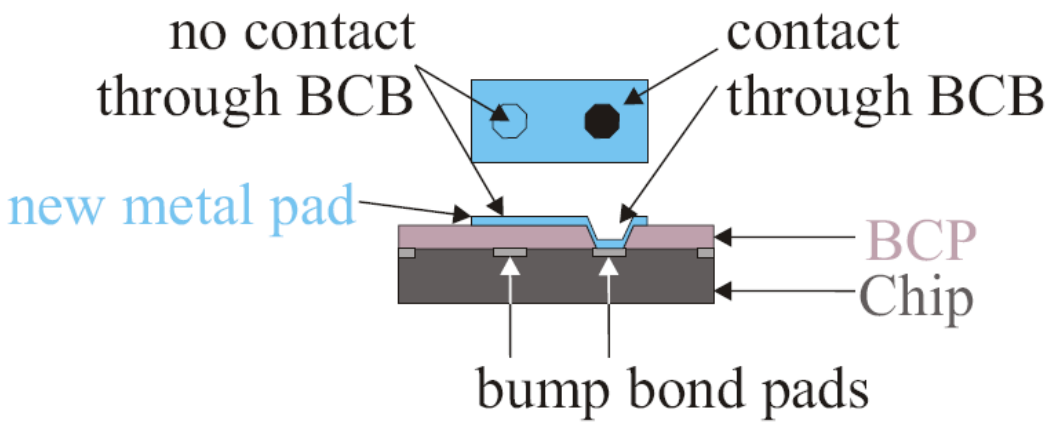
=> pixel sizes are too small for the charge clouds generated by a triple GEM stack

=> high gains (60,000 – 100,000) are necessary for the signal to pass over threshold of pixels

TEST CHIPS WITH LARGER PIXELS

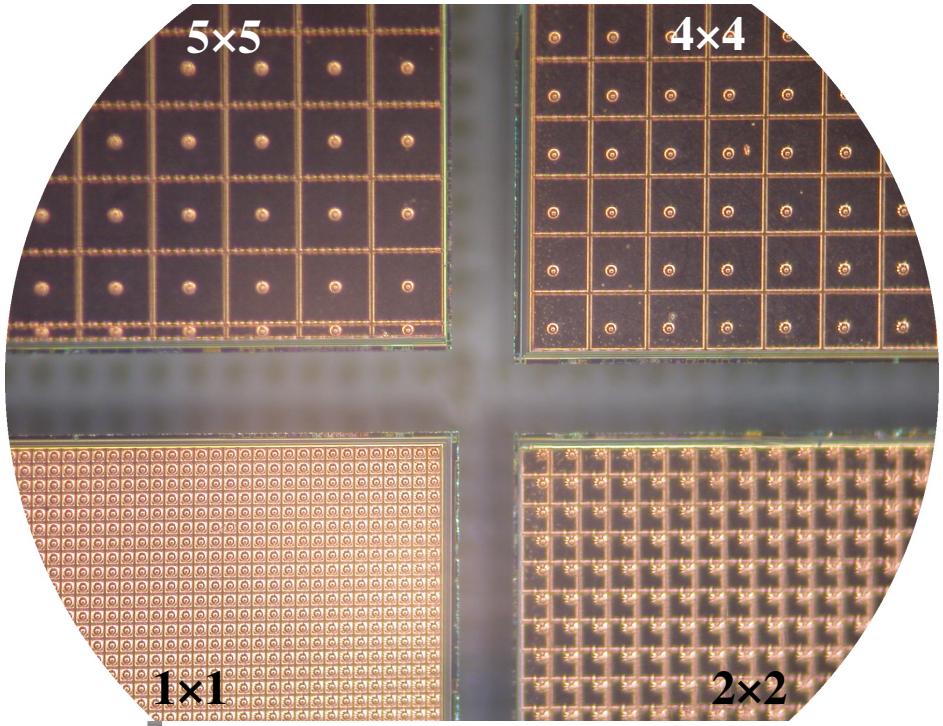
expensive to design new chips

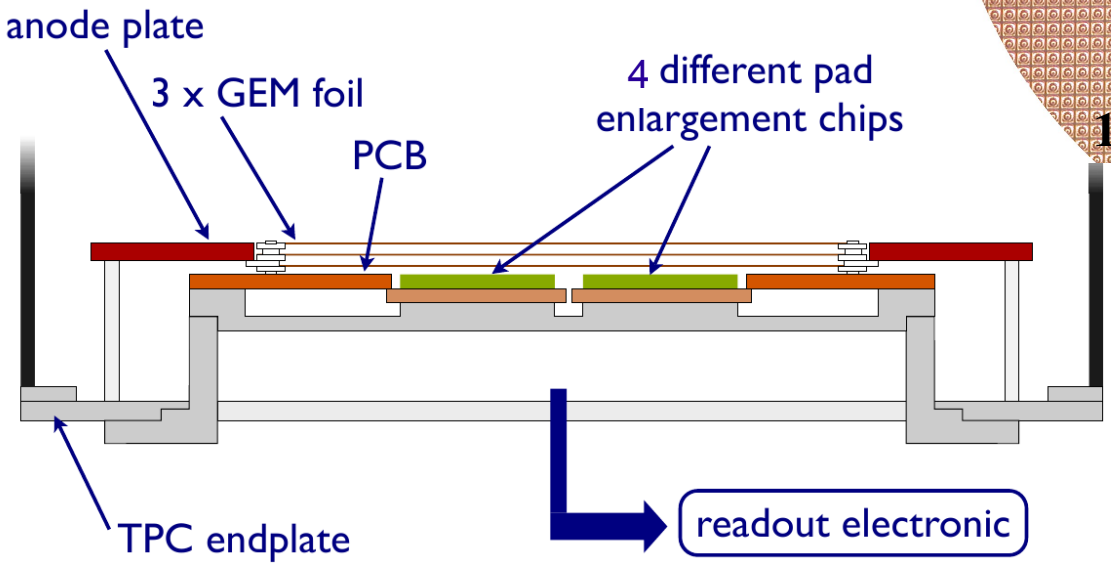
easier to combine pixels by adding new layers



Timepix with Larger Pixels

- 9 different geometries have been produced by IZM, Berlin.
- 4 have been tested during the test beam: 1×1 (for comparison), 2×2, 4×4, 5×5





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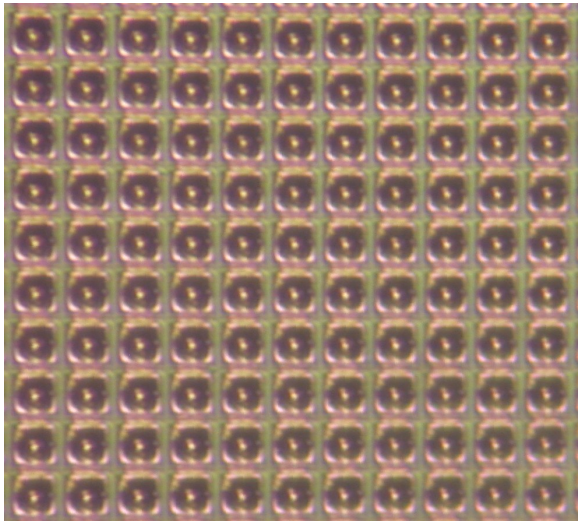
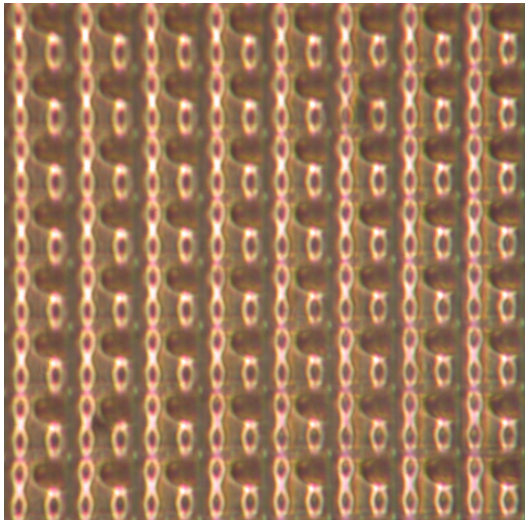
Closeup View of Chips

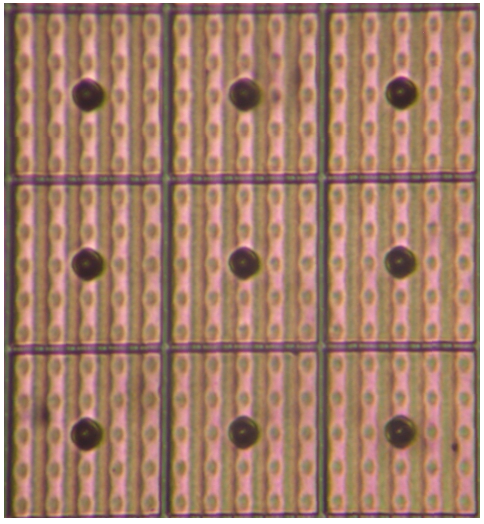
1×1-chip



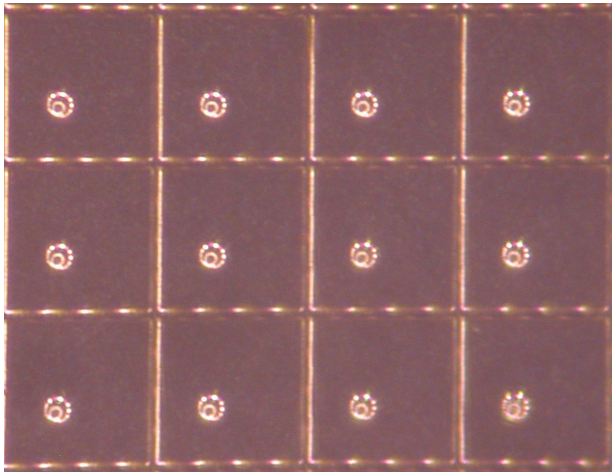
2×2-chip

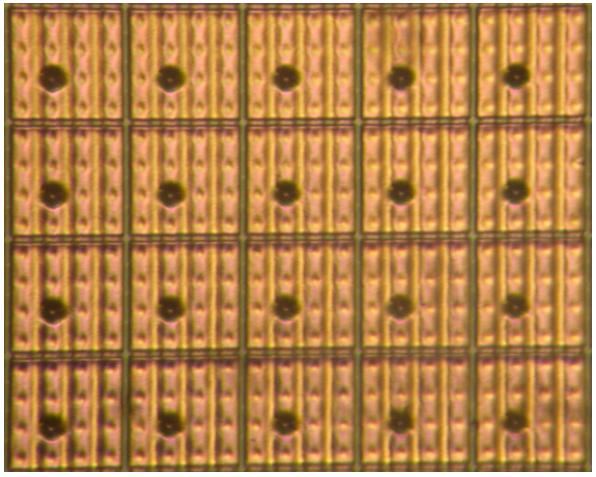


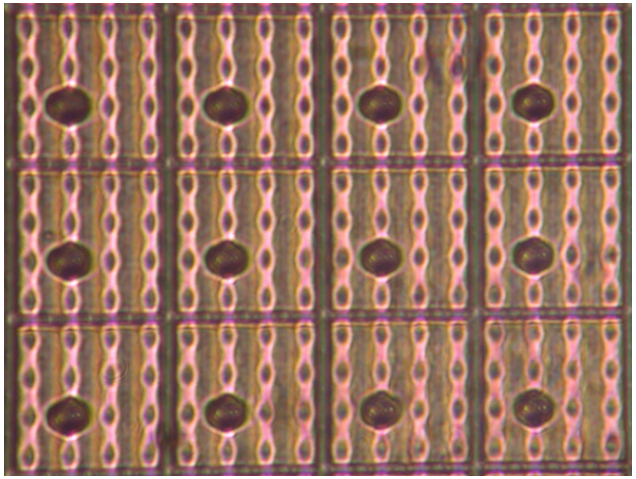
5×5-chip



4×4-chip seen with different incidence of light

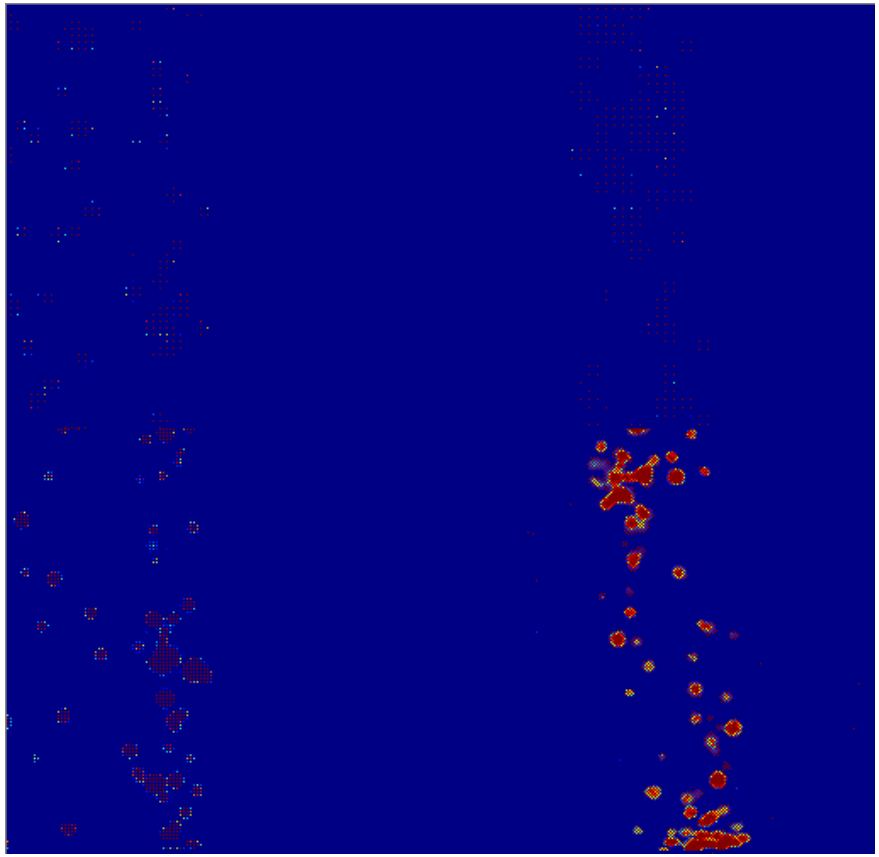




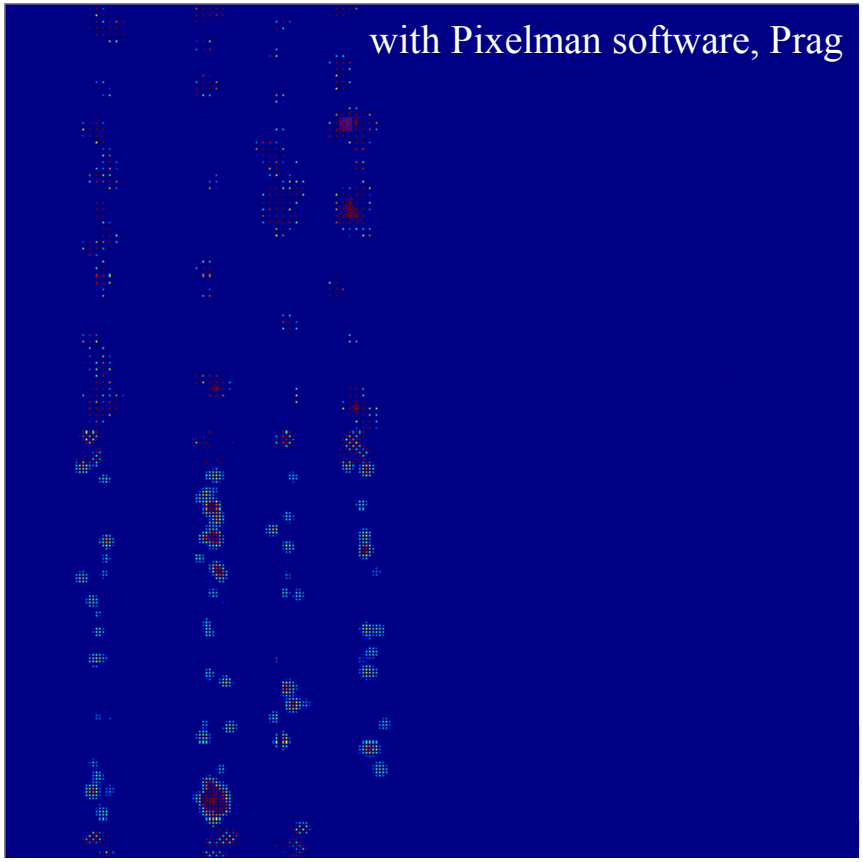


Some Pictures from the Online Display

- muons at 150 G*e*V
- drift distance: 25 cm
- 425 V across each GEM



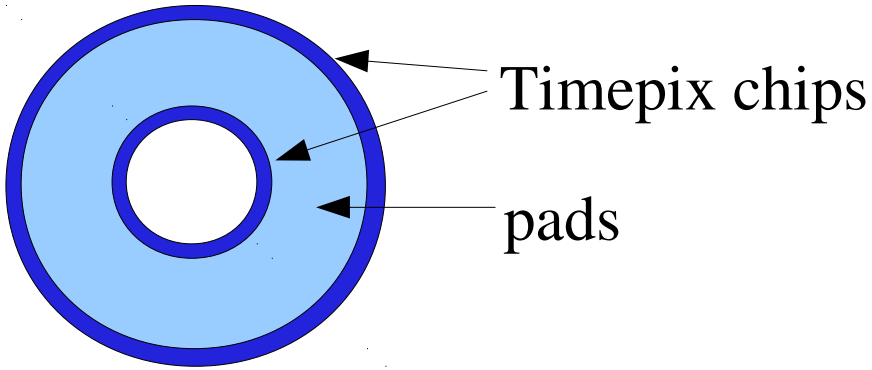
- muons at 150 G*e*V
- drift distance: 5 cm
- 425 V across each GEM



Goal 2 for the test beam: Combination Pads and Pixels

Large number of pixels may not be necessary everywhere on the TPC endcap.

Maybe only 2 rings are sufficient:



Combination of both pixels and pads on one endcap.

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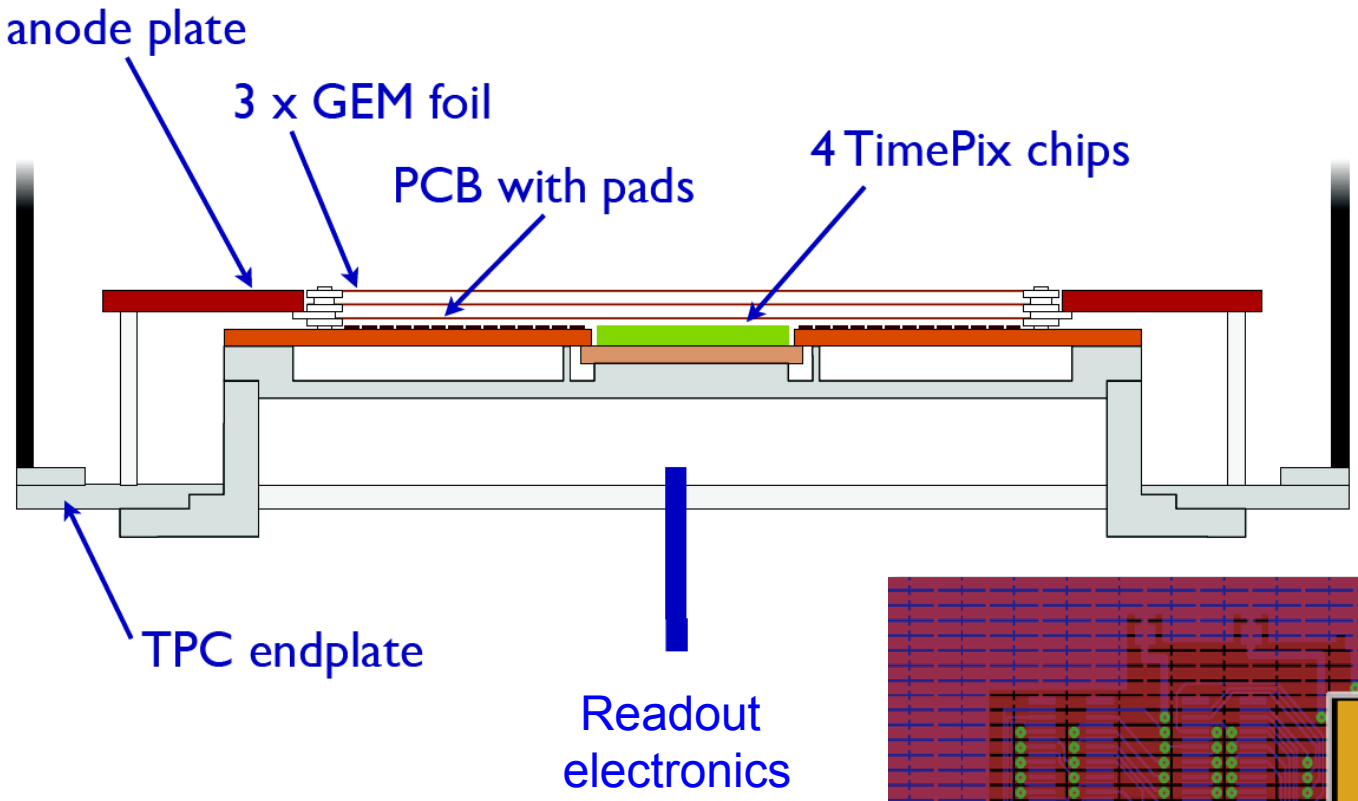
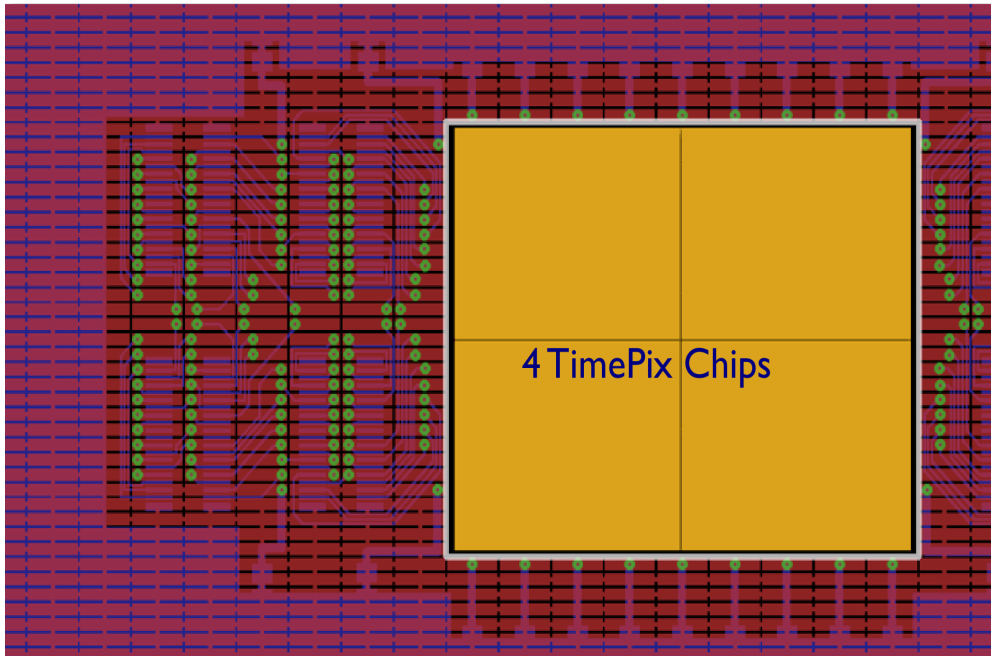
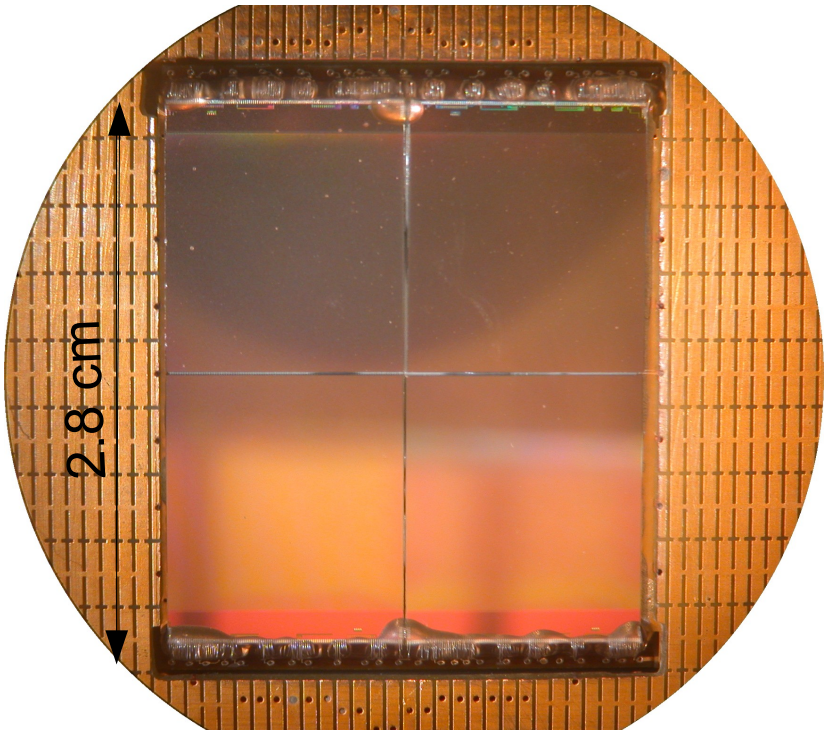
Test Combination of Pixels and Pads

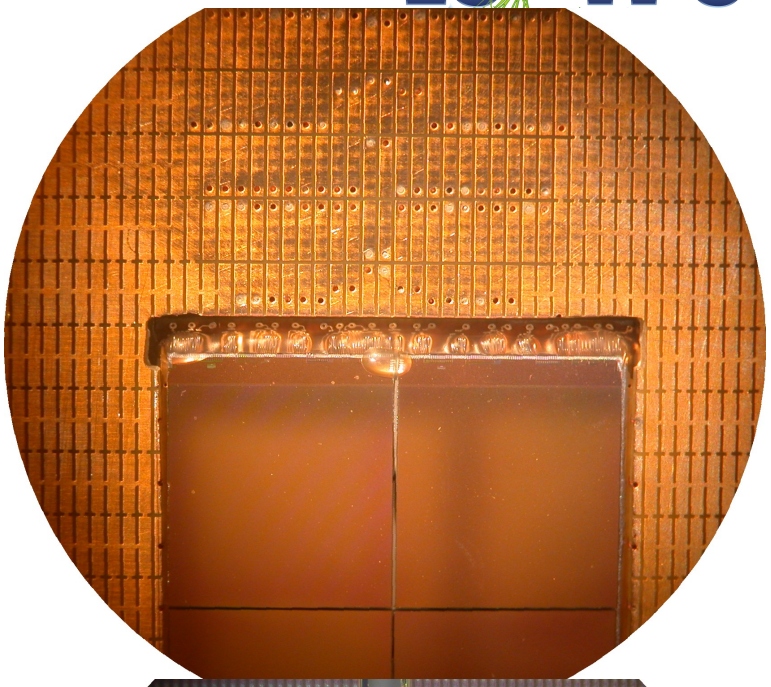


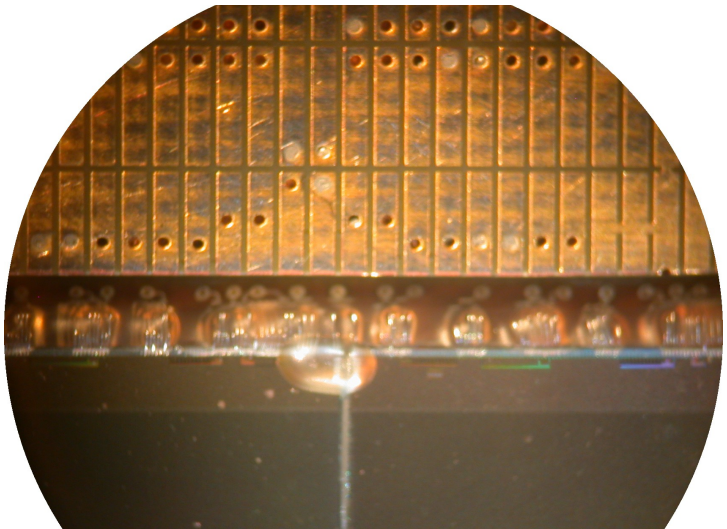


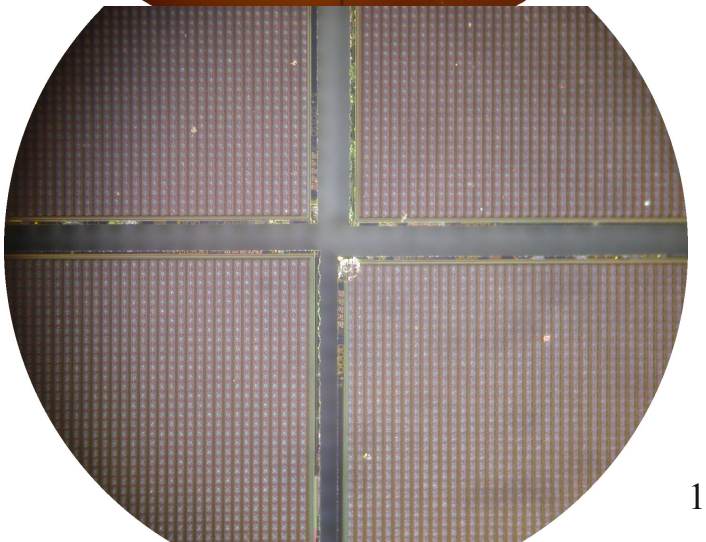
- Pad sizes 4x1 mm²
  connected to 256 channels
  of ALTRO electronics
- 4 Timepix chips in the middle

Pictures from the Readout



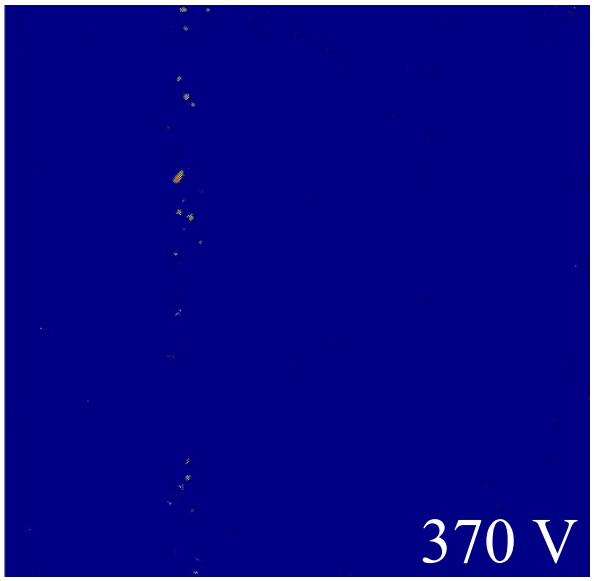


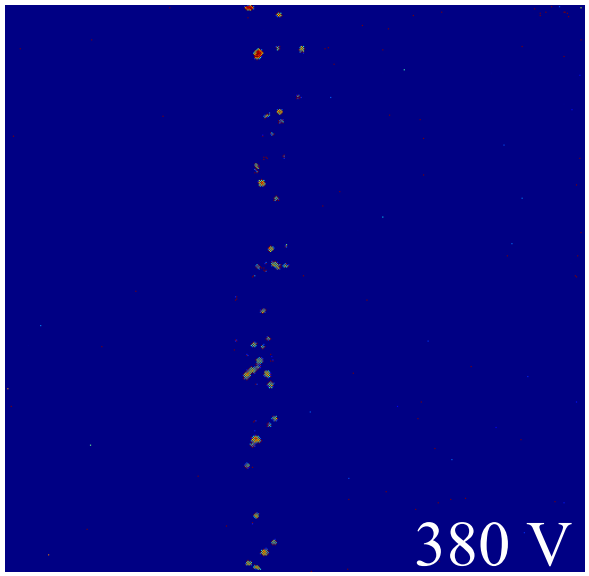


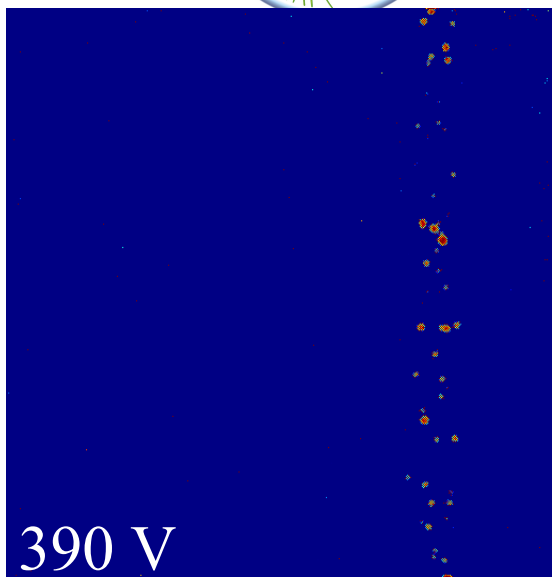


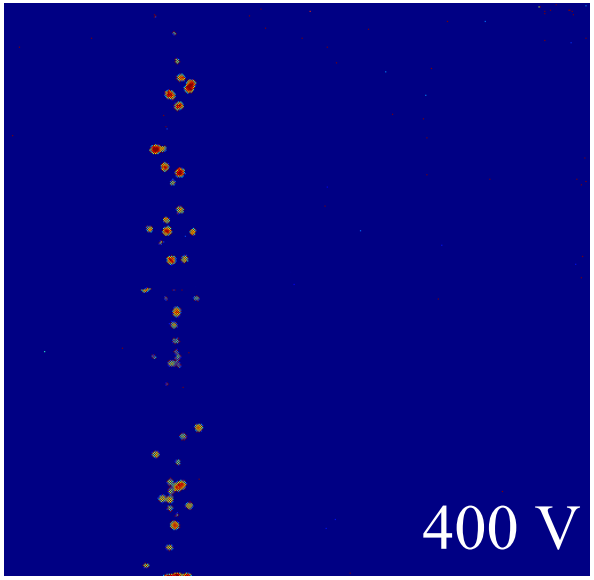
Voltage Scan as Seen by Online Monitor

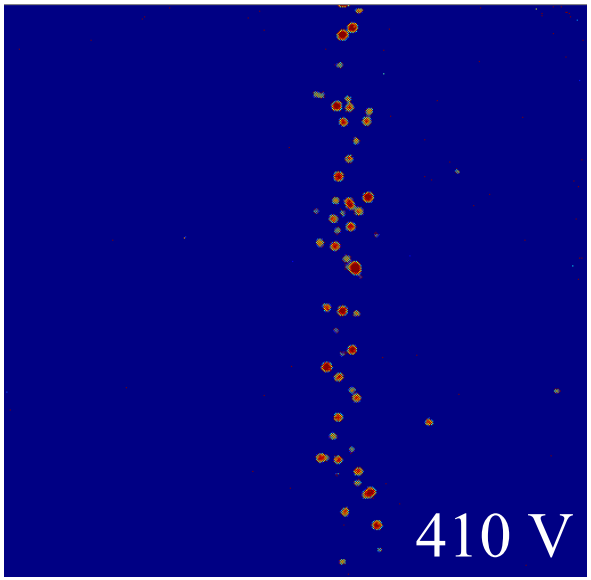
150 GeV muons after drifting 25 cm

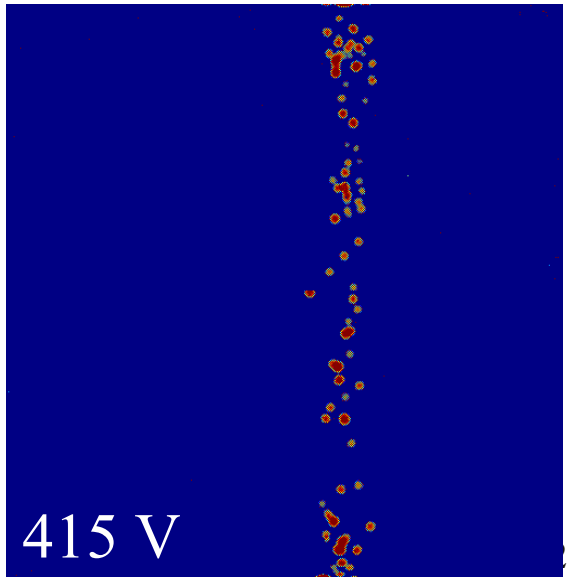




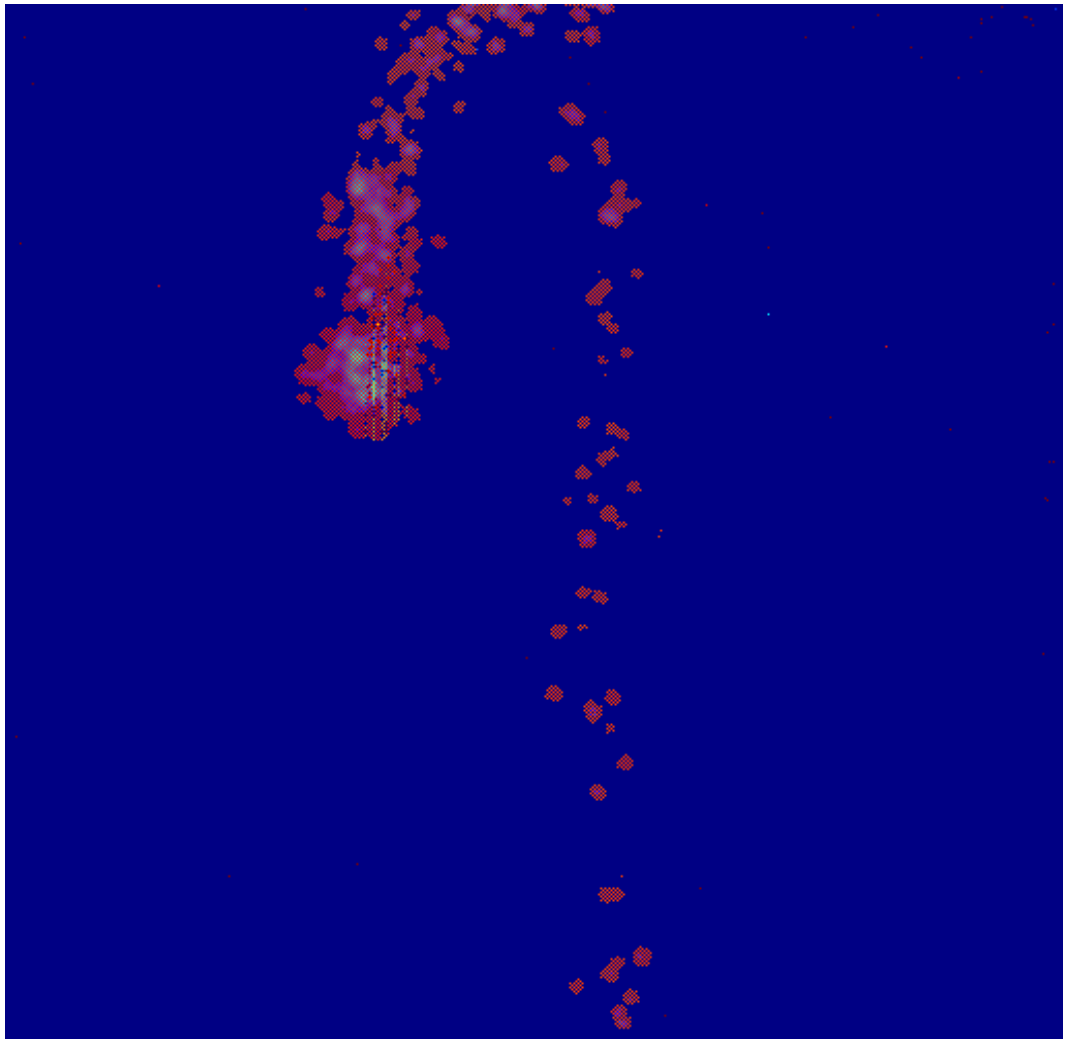








Summary



In both cases we took the following data:

- increasing the voltage
  at short (5 cm) and
  long (25 cm) drift distances
- changing the drift distance
  (5 - 25 cm in ~1 cm steps)
  at high voltages
- changing the track inclination
  in the readout plane

About 1,000 – 2,000 events per measurement

Analysis has started.