New Results of TPCs with GEMs and Pixelized Readout

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GEFÖRDERT VOM
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und Forschung

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PHYSICS AT THE TERA SCALE
Helmholtz Alliance

Test Beam results of a TPC with a GEMs and 'pad-enlargement' Timepix chips

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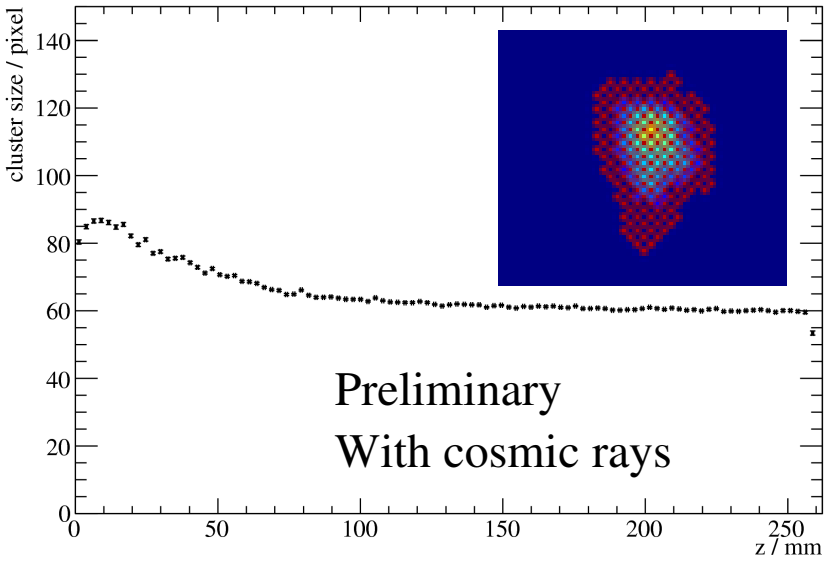
Universität Freiburg

For more details see presentation of M. Schultens in WG7

Larger Pixel Sizes



Charge depositions are spread over ~60 pixels

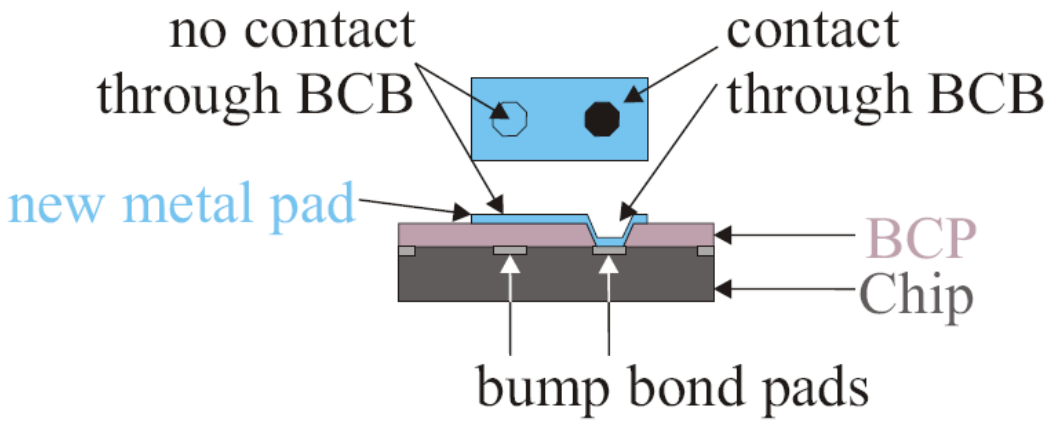
=> pixel sizes are too small for the charge clouds generated by a triple GEM stack

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

TEST CHIPS WITH LARGER PIXELS

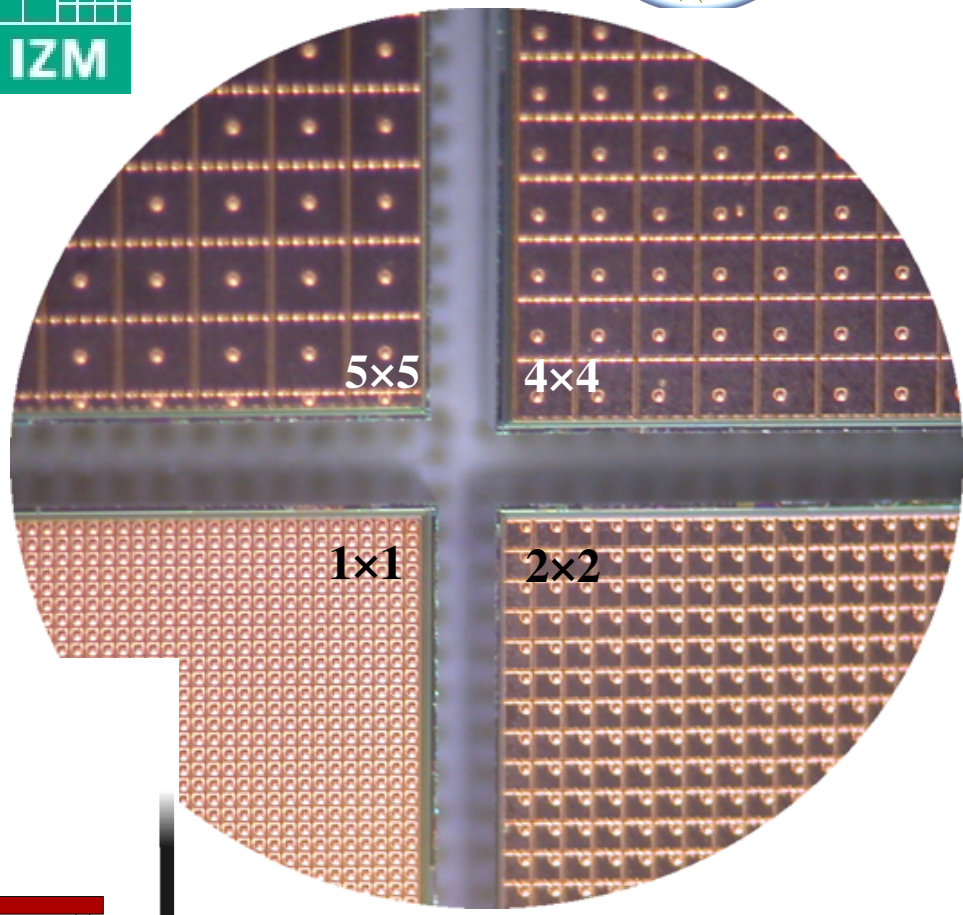
expensive to design new chips

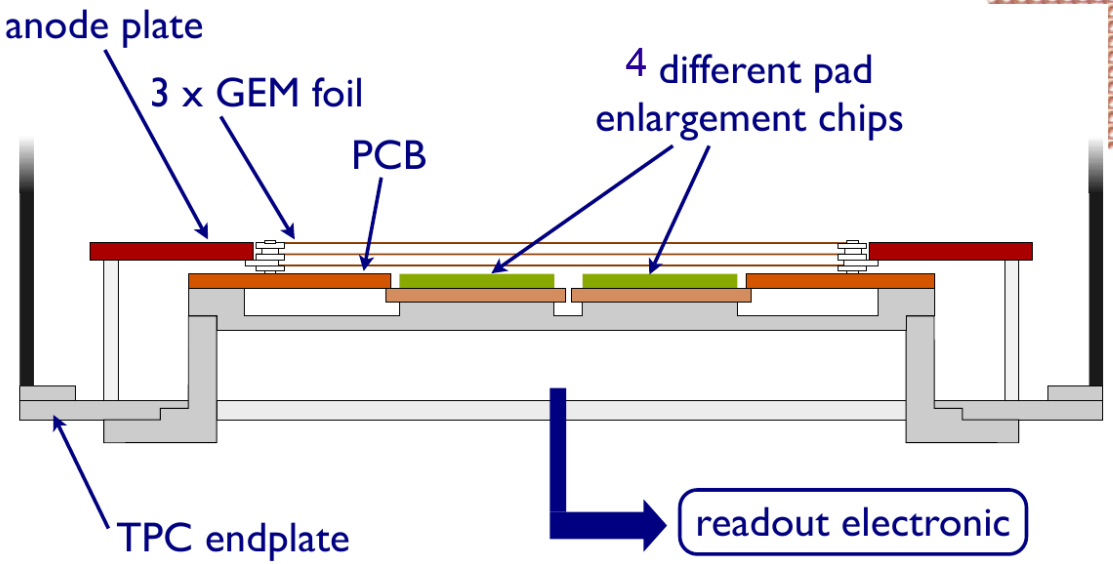
easier to combine pixels by adding new layers



Timepix with Larger Pixels

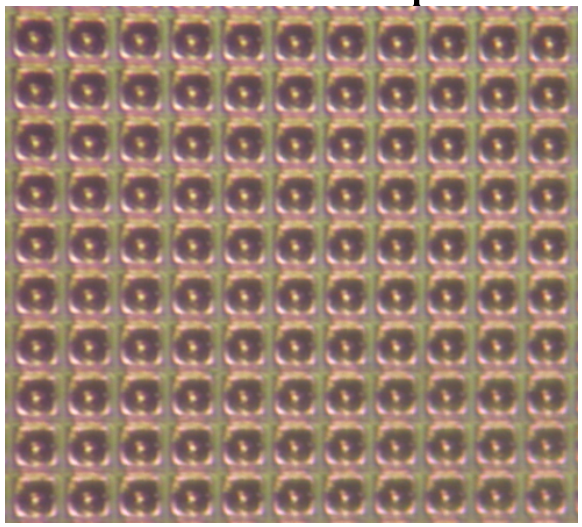
- 9 different geometries have been produced by IZM, Berlin.
- 4 have been tested during the test beam: 1×1 (for comparison), 2×2, 4×4, 5×5



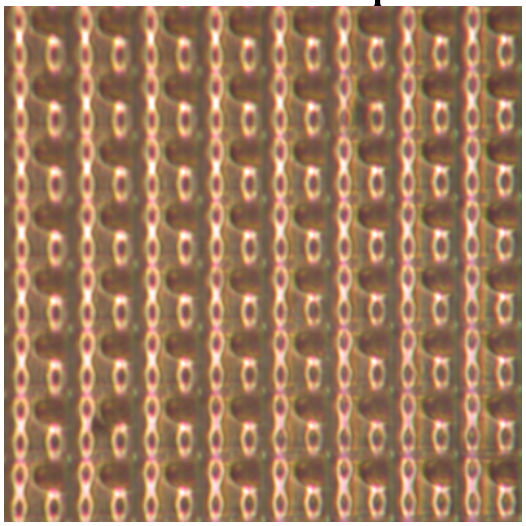


Closeup View of Chips

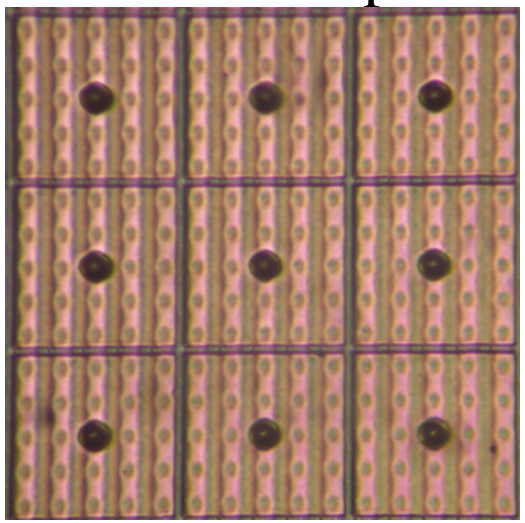
1×1-chip



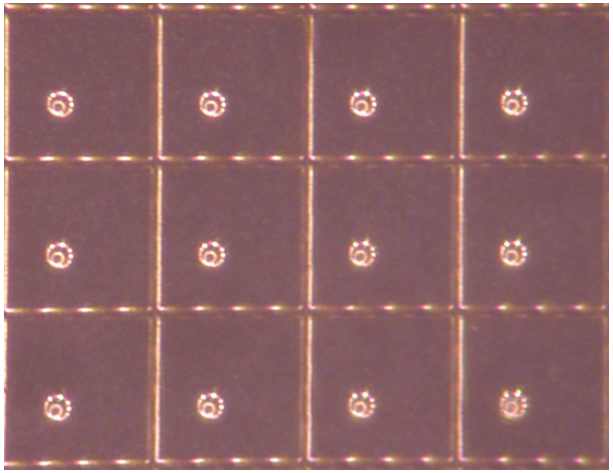
2×2-chip

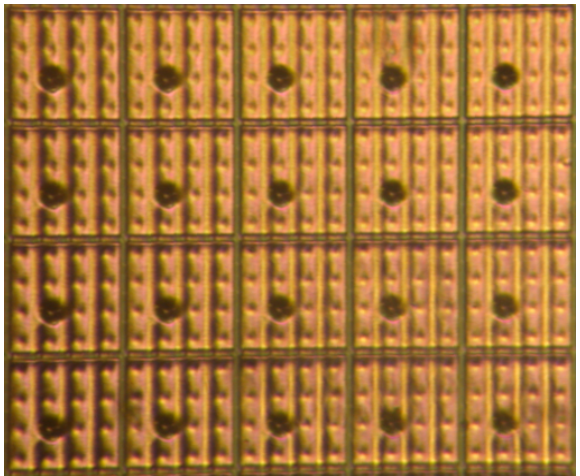


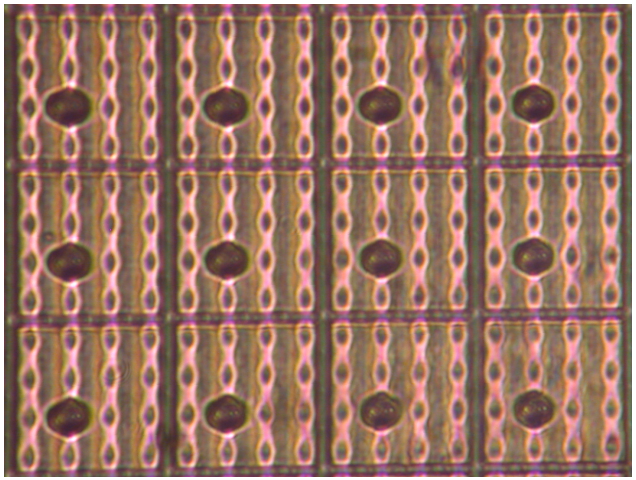
5×5-chip



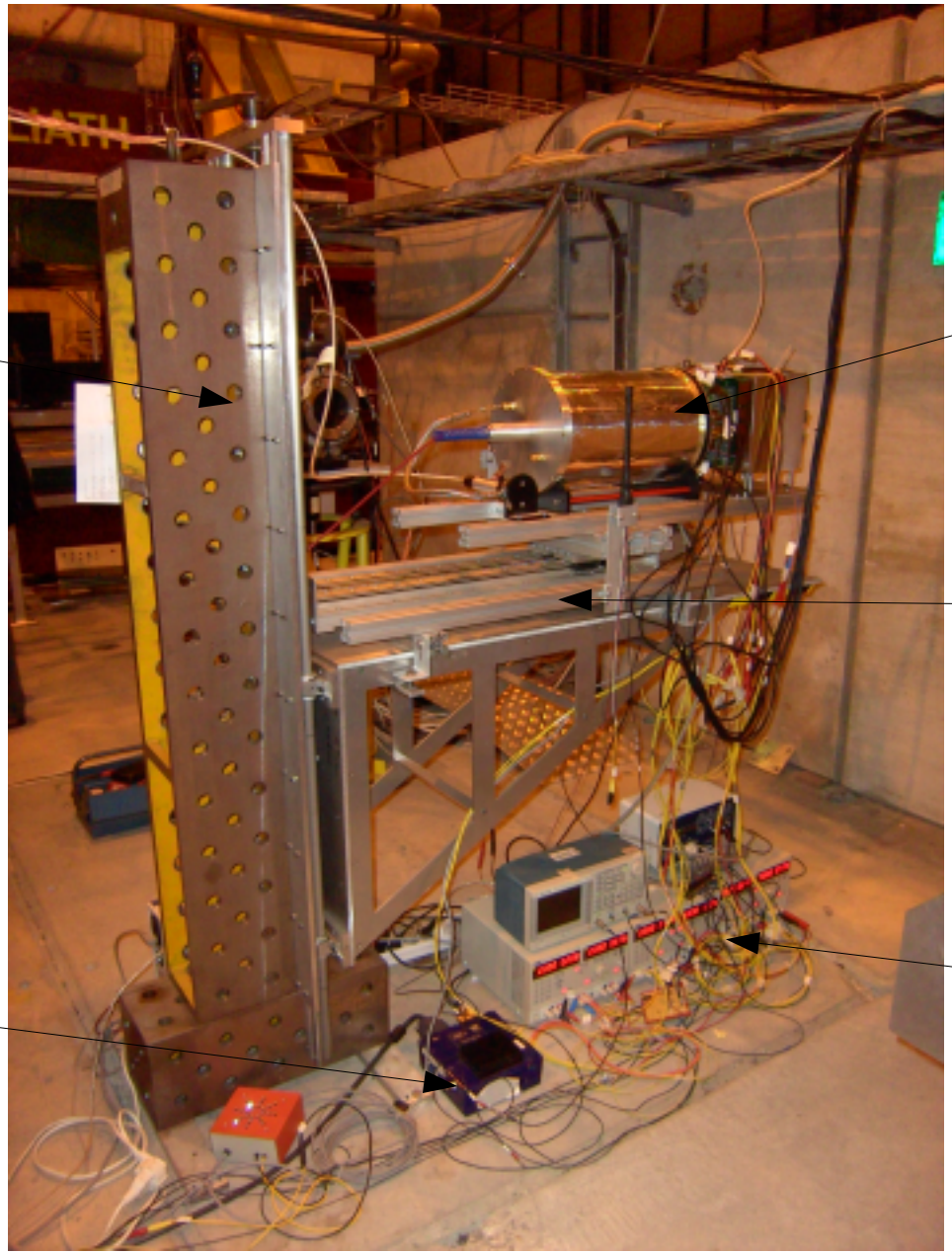
4×4-chip seen with different incidence of light





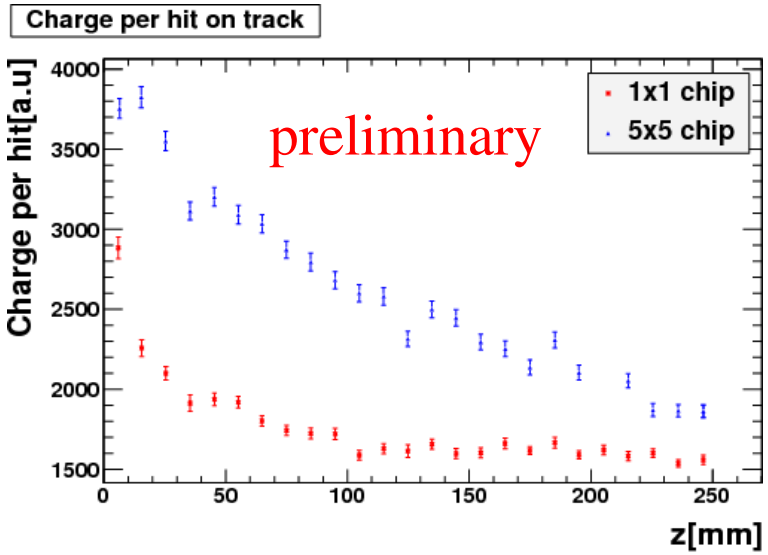


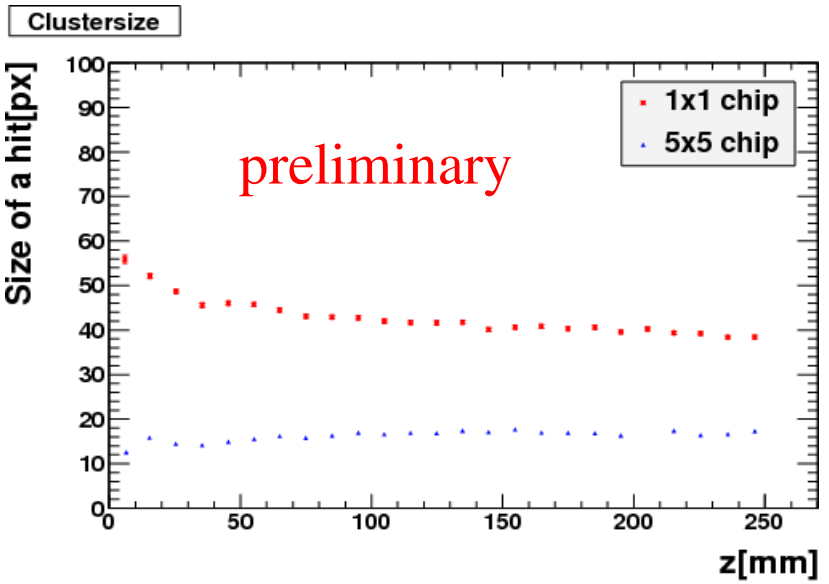
Setup in the Test Beam Area

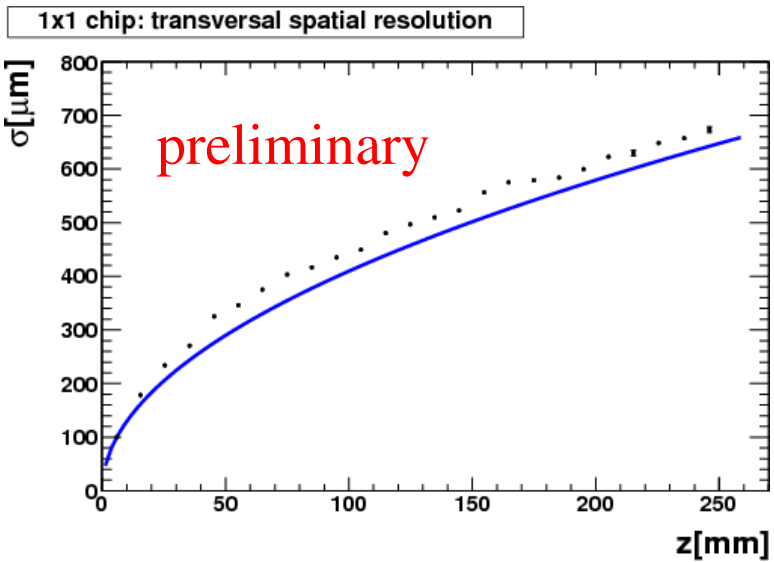


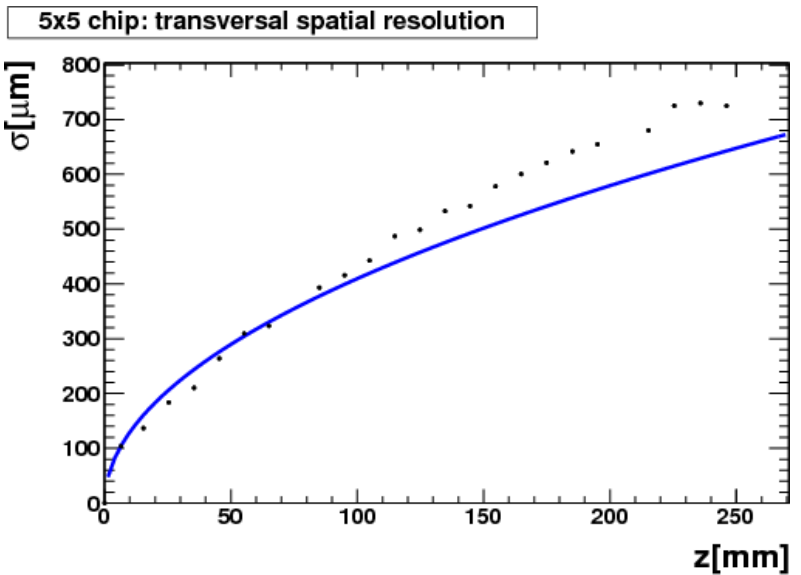
Preliminary Results

Sofar, only data from 1x1 and 5x5–chips have been analyzed.







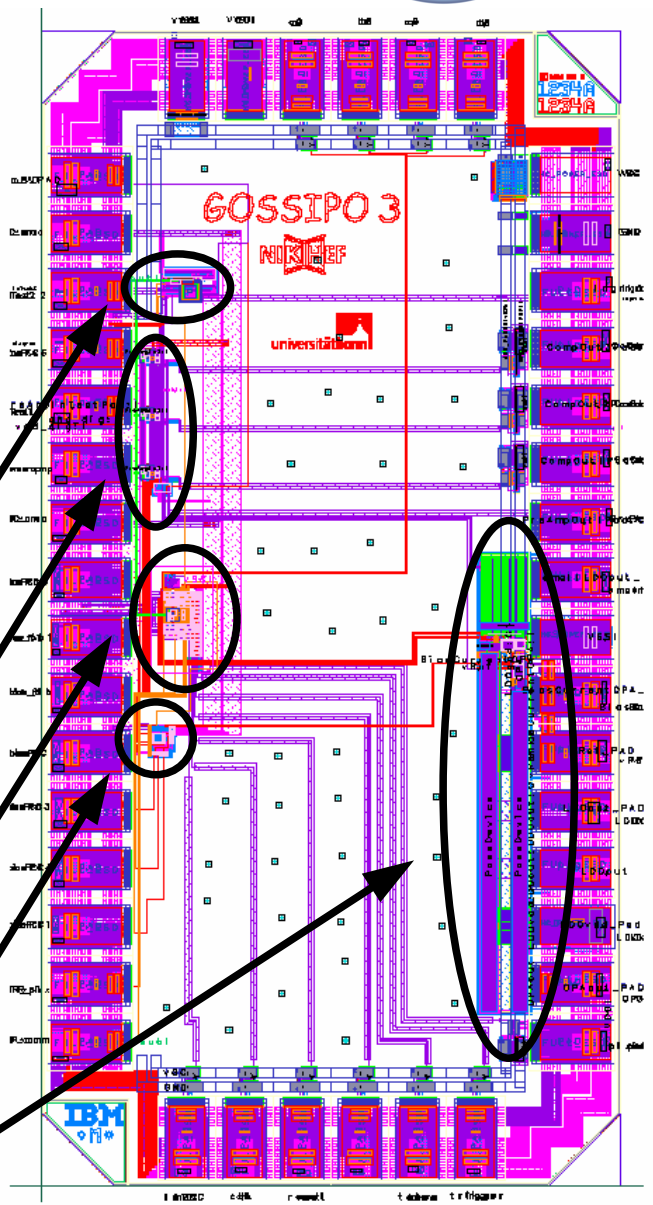


GOSSIPO3

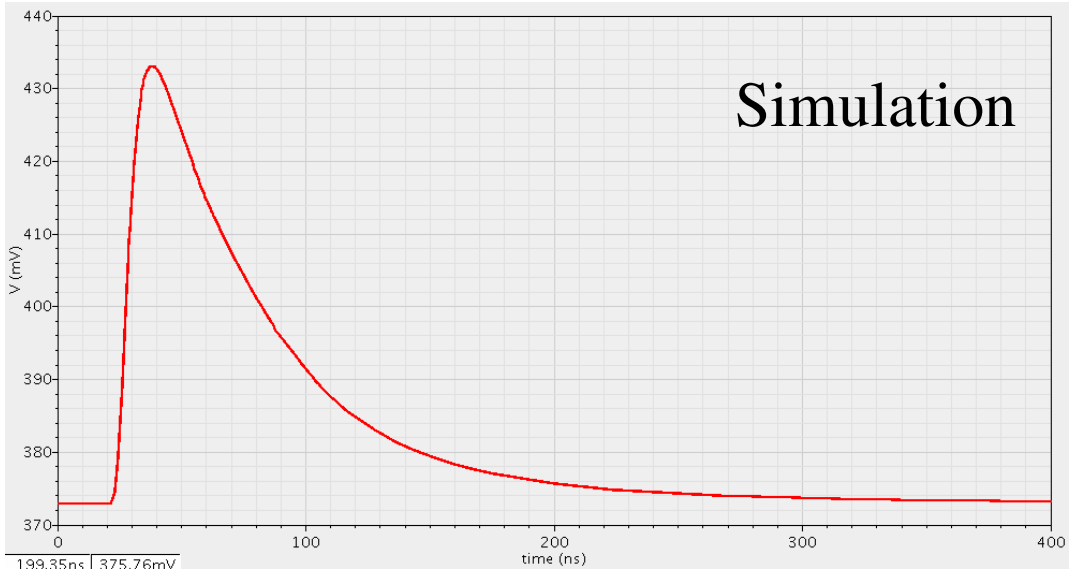
C. Brezina, K. Desch, A. Kruth – University of Bonn
V. Gromov, R. Kluit, F. Zappon – NIKHEF / Amsterdam

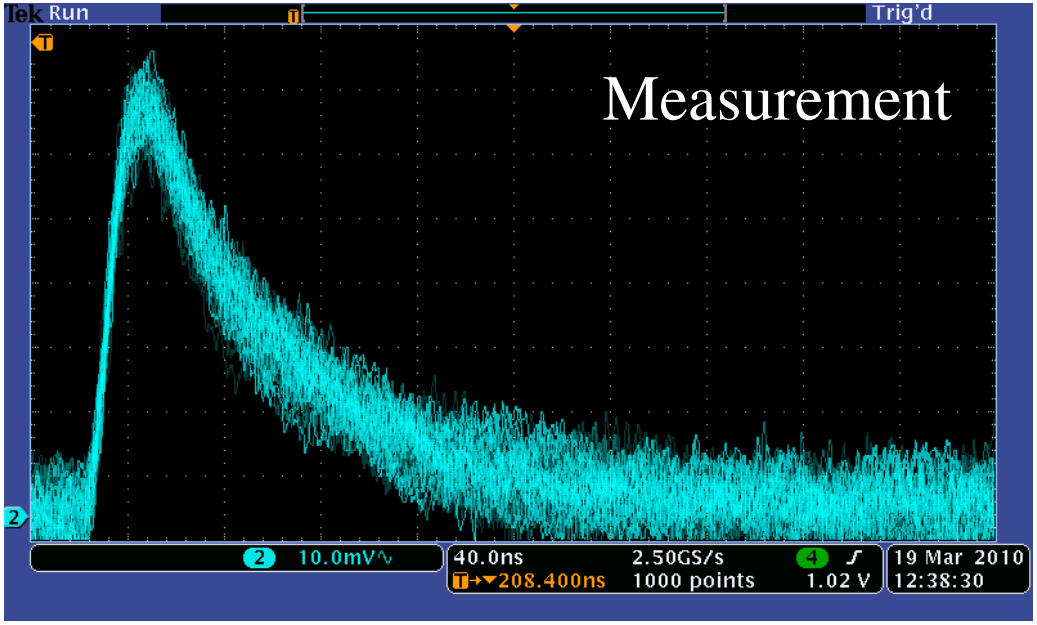
GOSSIPO-3: Main Features

- Technology: 130 nm IBM CMOS
- Pixel size: 60 x 60 µm²
- Time measurement mode or counting mode
- Drift time: up to 100 µs
- Accuracy (bin size of high res. TDC): 1.7 ns
- Rise time: 20 ns
- ToT: up to 6.4 µs (~ 28 ke$^-$)
- ToT accuracy: 200 e$^-$ (~ 27 ns)
- Noise: < 70 e$^-$
- Power goal: 3 µW/ch



GOSSIPO-3: Preamp Test



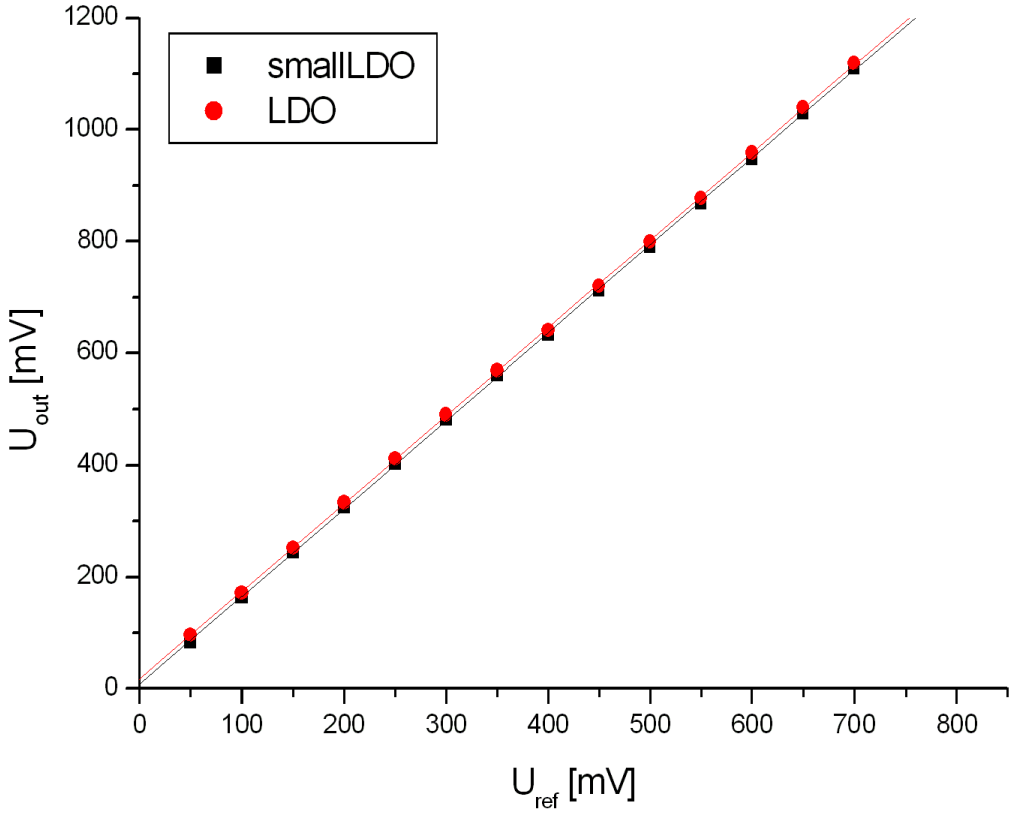


Preliminary

- Noise: ~ 3 mV
- Gain: ~ 120 µV/e^-
  => ENC ~ 25 e^-

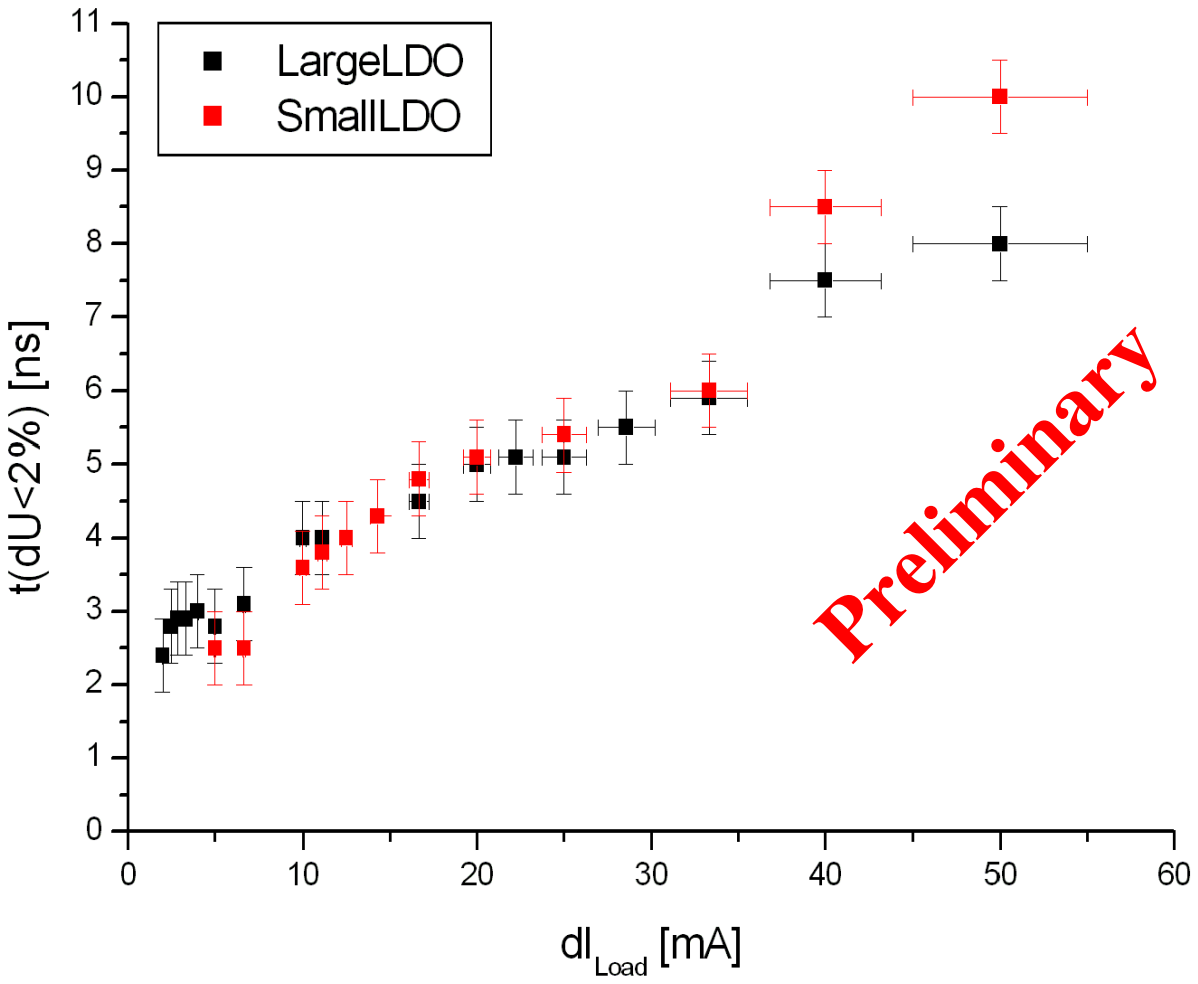
GOSSIPO-3: LDO Linearity Test

- Expected: $U_{out} = U_{ref} * (1 + R_1/R_2) = U_{ref} * 1.57$
- Measured: $U_{out} = U_{ref} * 1.57$
  - Offsets of small LDO and LDO deviate by 10mV (as expected)



GOSSIPO-3: LDO Step Response

Time needed to recover within 2% of target $U_{\alpha t}$



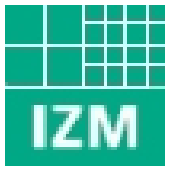
GOSSIPO-3: Summary

- GOSSIPO-3 is a pixelated prototype ASIC for MPGD read-out it features:
  - High resolution TDC (1.7 nsec)
  - Dynamic range up to 100 μs
  - Low noise

- Design and testing of Chip and testboard by NIKHEF and University of Bonn
- Results will be used in Timepix2, designed within the Medipix3 collaboration

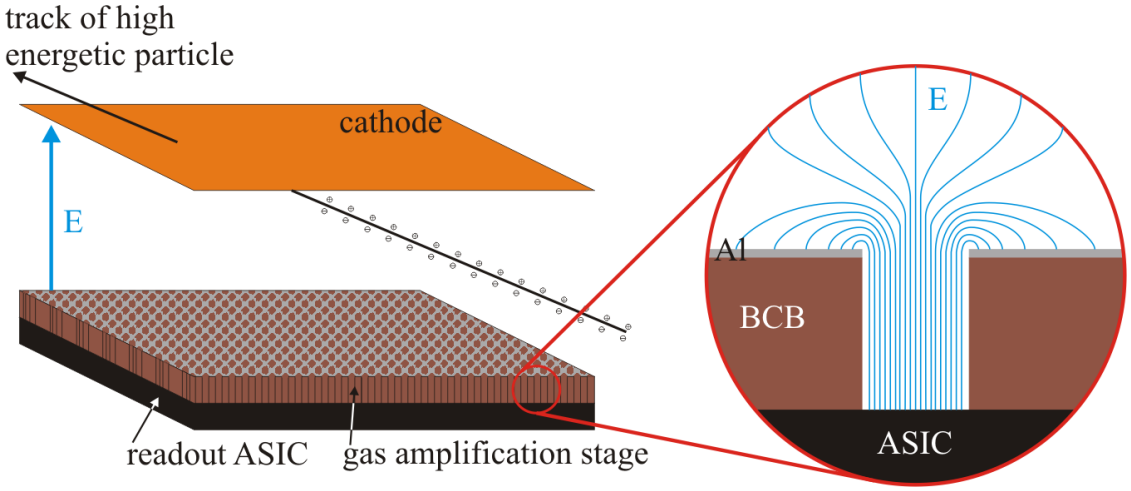
GEMGRID - Production

K. Desch, J. Kaminski, Th. Krautscheid – University of Bonn
T. Baumgartner, O. Ehrmann, Th. Fritzsch, S. Mayer, M. Töpper – IZM, Berlin



GEMGrid

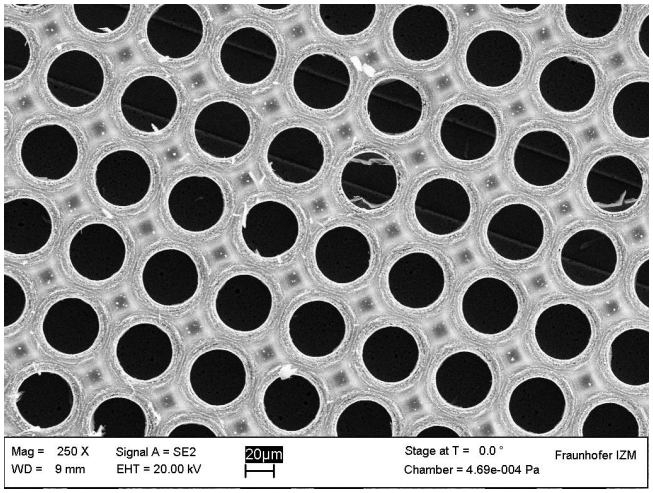
At GEMGrid the grid does not rest on pillars like at InGrids, but on a solid insulating layer with holes.

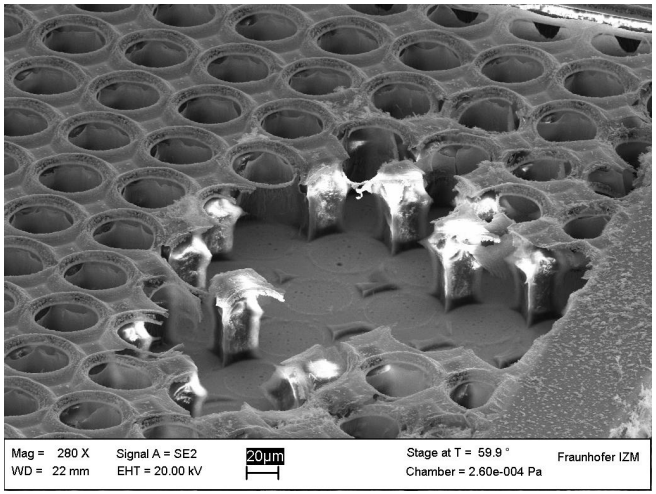


Very good InGrids have been produced at the University of Twente.
But: Productions based on single chips :-(

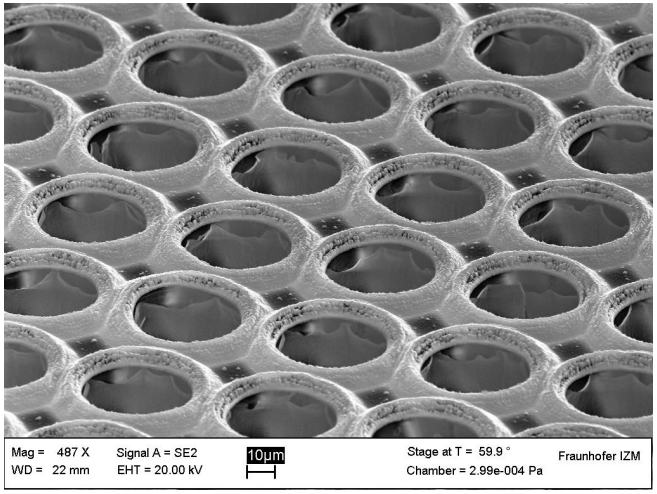
Have to transfer the knowledge to a more industrial process.
IZM at Berlin has produced a first wafer with 'dummy'-GEMGrids.
a bare Si-wafer with an aluminum pad and a GEMGrid.

SEM-Pictures of First Dummies



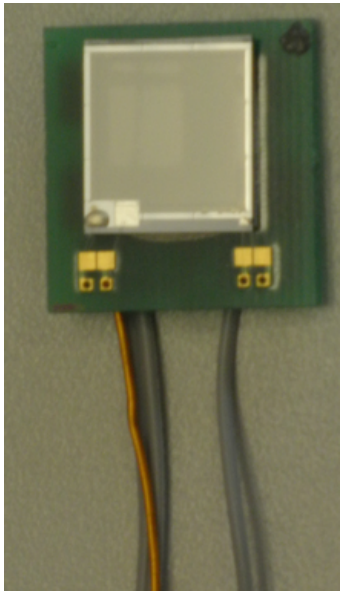


Pitch of the holes is 55 µm.

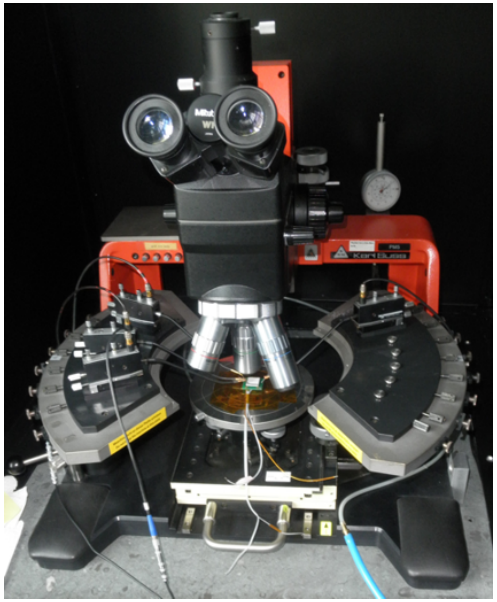


Small walls (2-3 µm) around the holes.

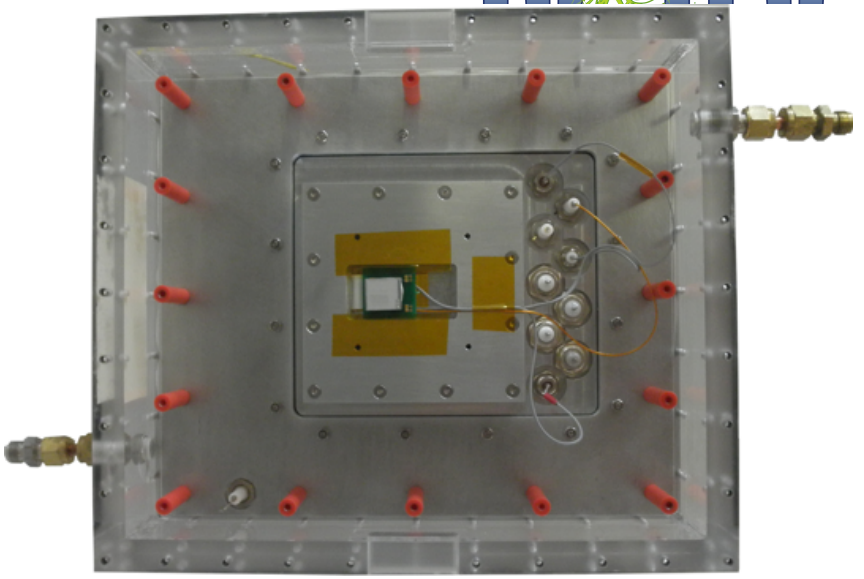
First Tests – Building a Detector



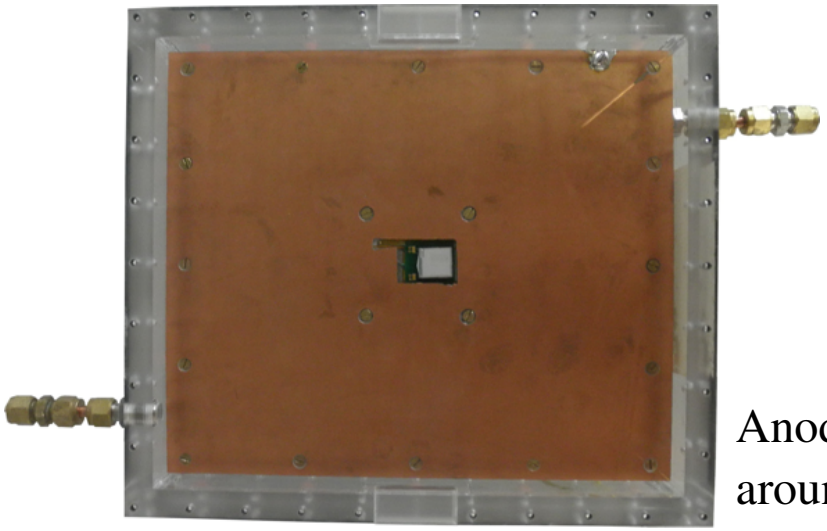
GEMGrid mounted on chip carrier.



GEMGrid placed in probing station to test leakage current.



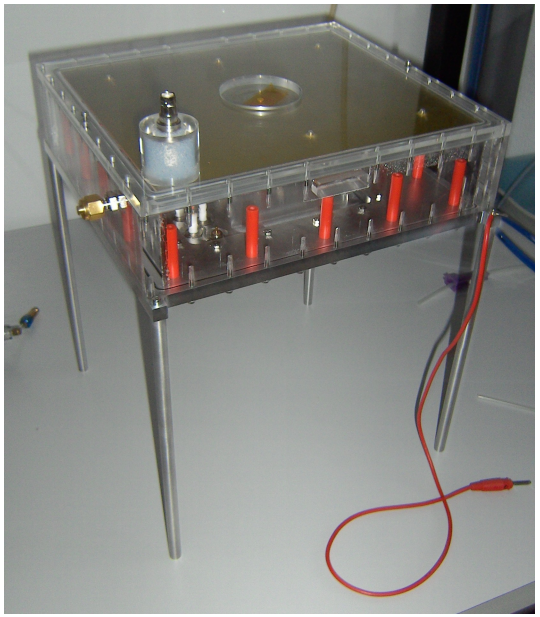
GEMGrid placed mounted in test detector.



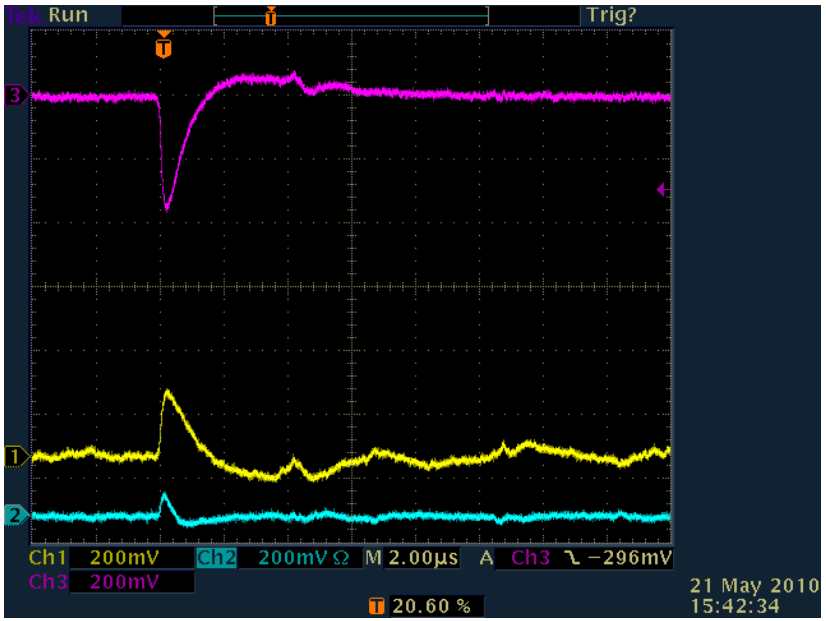
Anode plane placed around the GEMGrid.

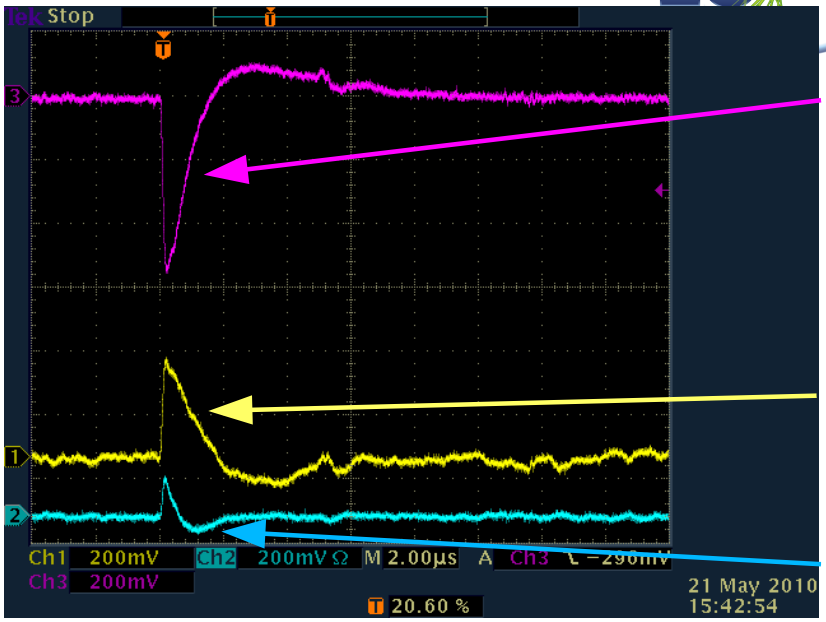
closed test detector

Ar:iButan 95:5
315 V on grid



First Signals with ^{90}Sr-source

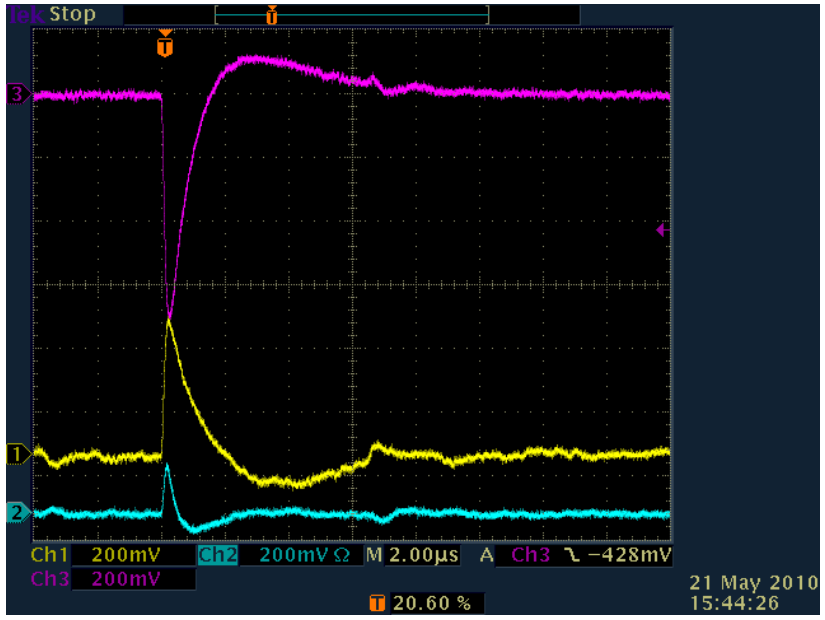


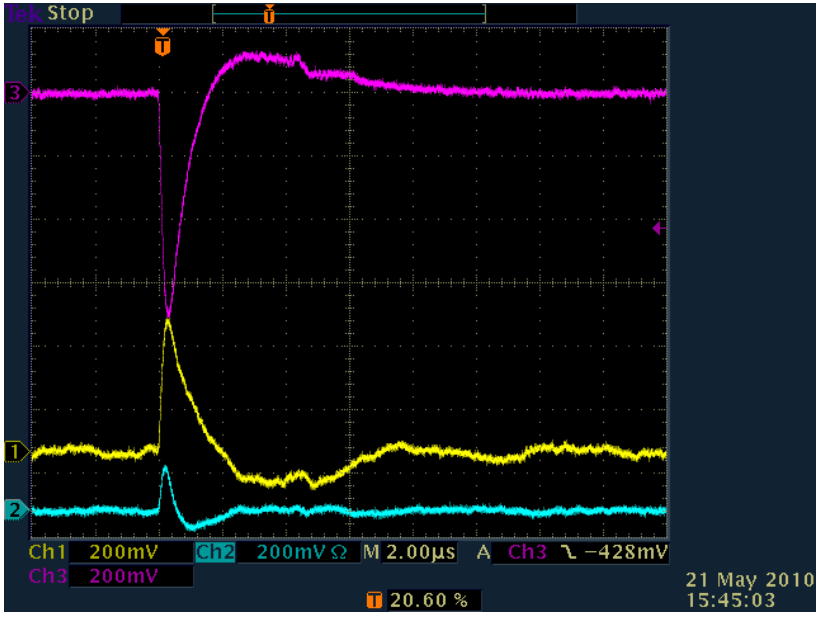


signal of grid

signal of pad

signal of ring





Rate highly correlated with rad. source!