Status of the DESY GEM Module

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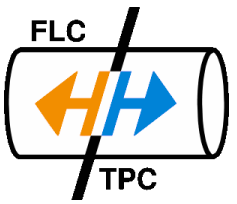
LCTPC collaboration meeting

26.03.2012

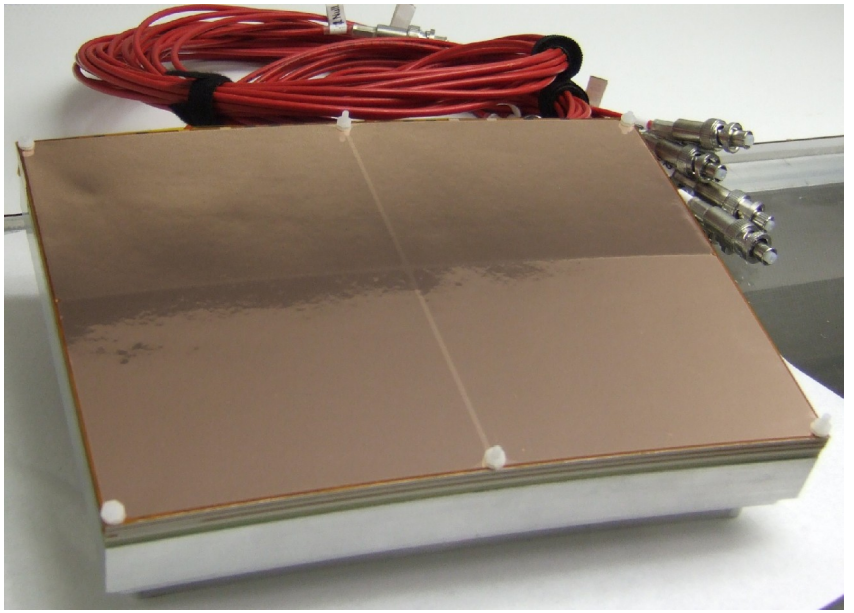


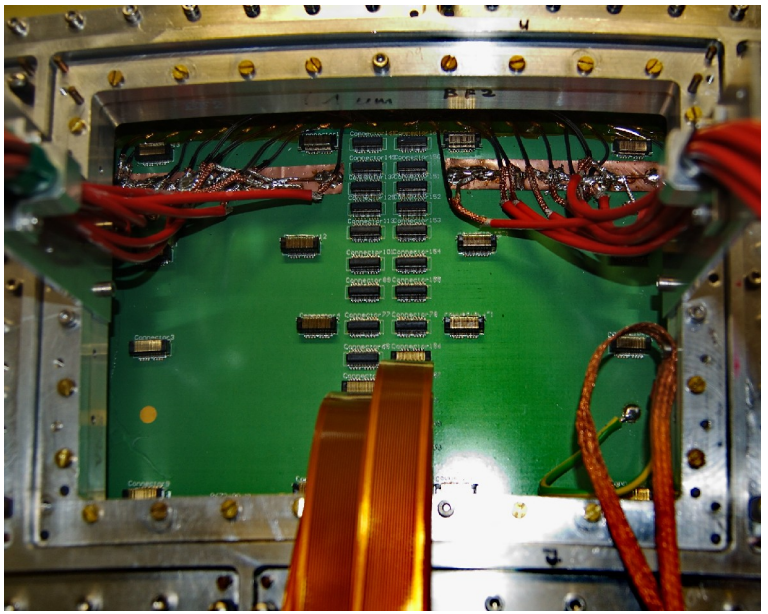
Overview

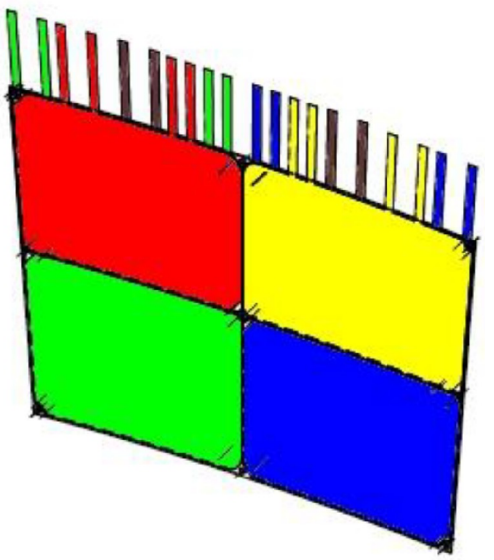
- Current DESY GEM module
  - Setup of the module
  - Performance of the module
  - Observed effects
- New module
  - Improvements
  - Status
- Conclusion

Current Module

- Triple GEM stack and optional forth gating GEM
- Segmentation of GEM
  - Reduce energy stored in one sector

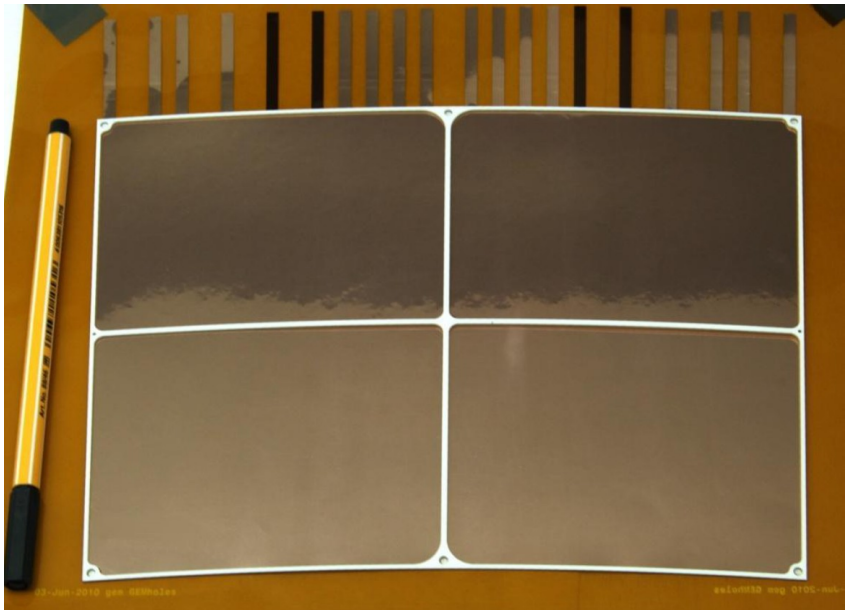






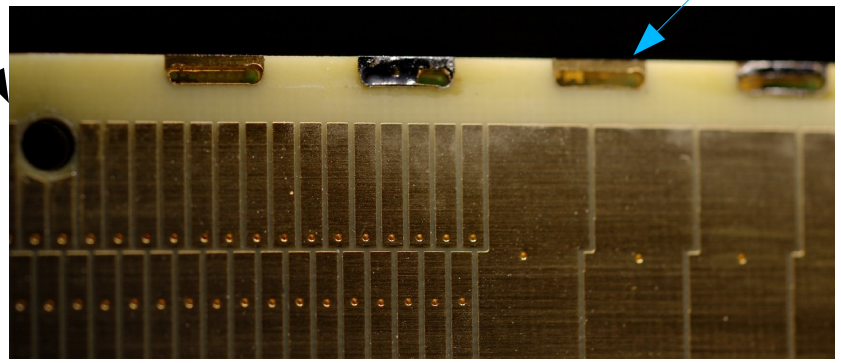
Current Module

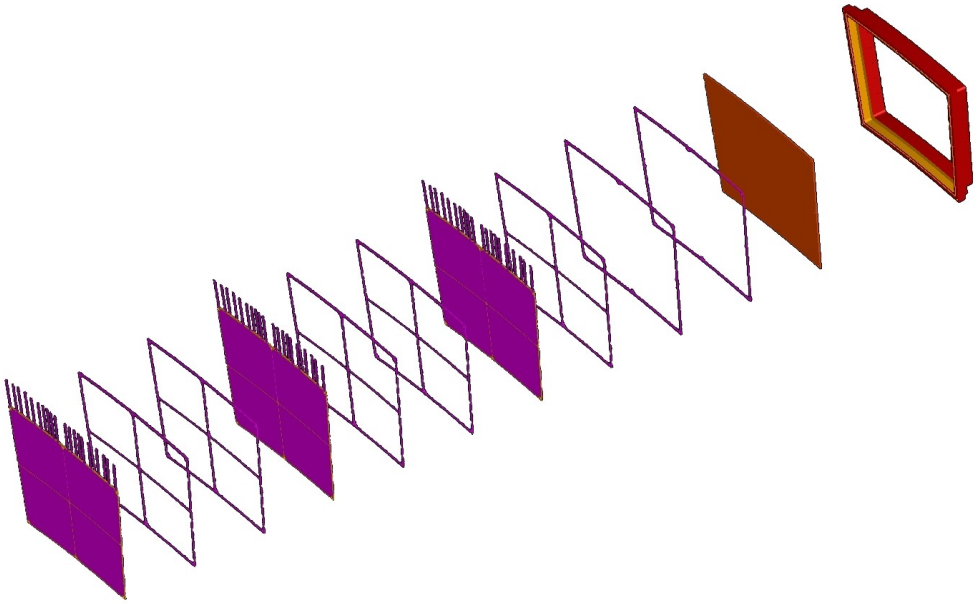
- Ceramic mounting structure
  - Mechanical support
  - Improve GEM flatness
  - Minimal dead space
- Small pads only at the center (1.26x5.85 mm^2)
- Larger pads connected to ground



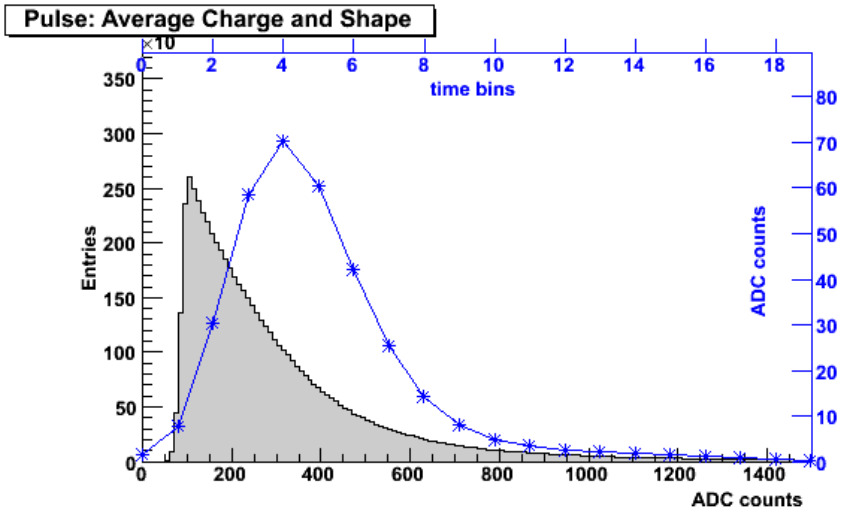
Alignment pins

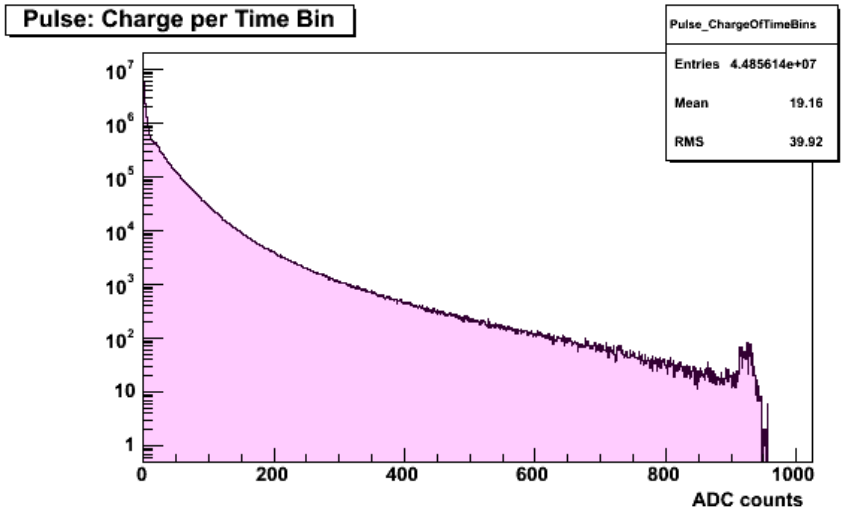
HV connection

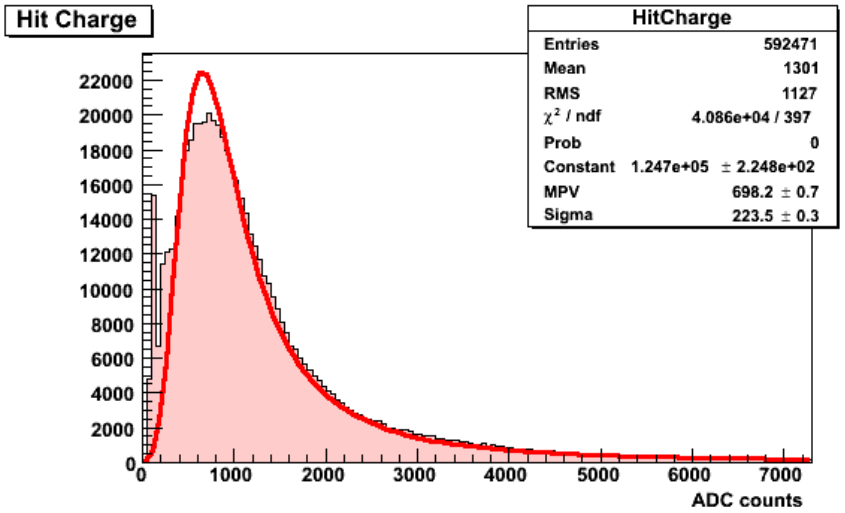


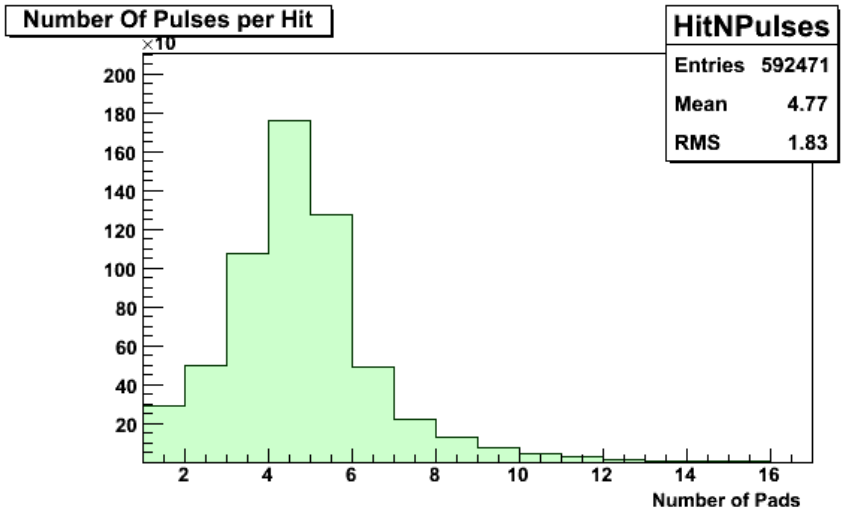


Performance of the current Module









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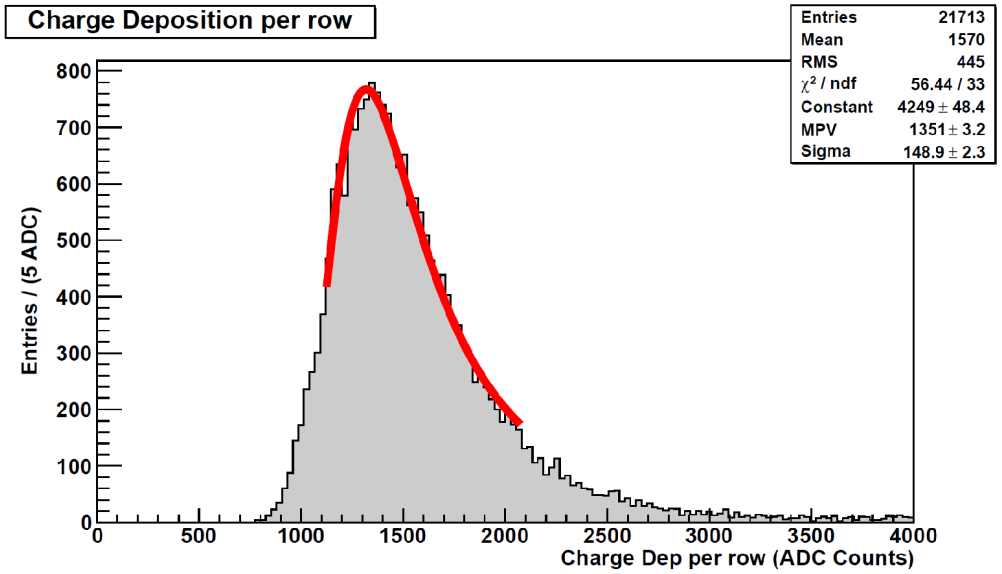
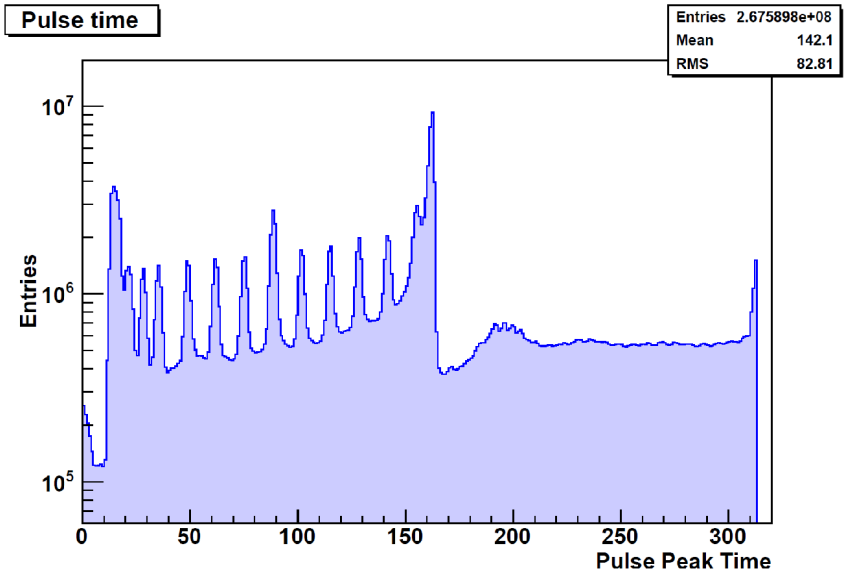
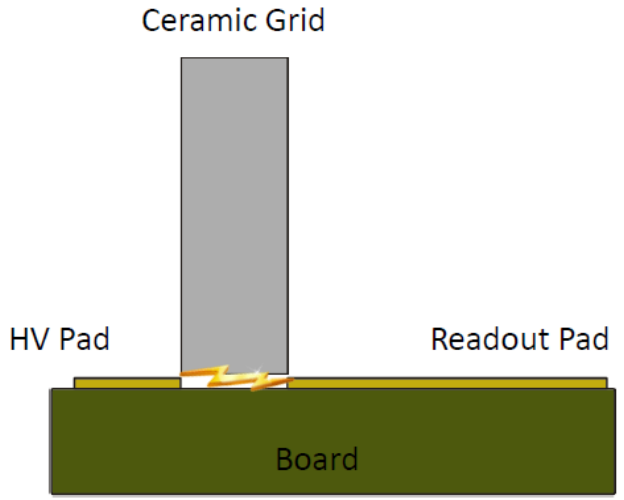
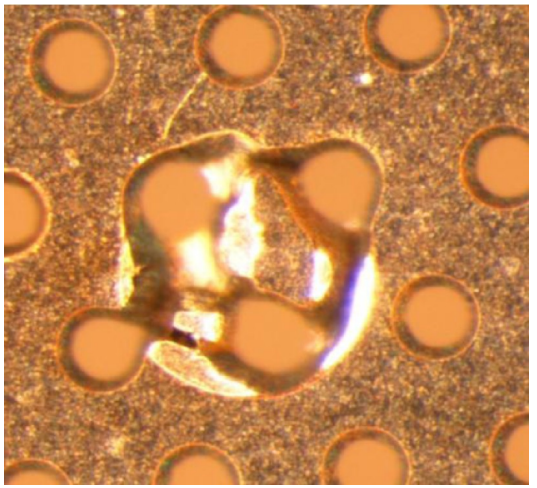




Problems observed

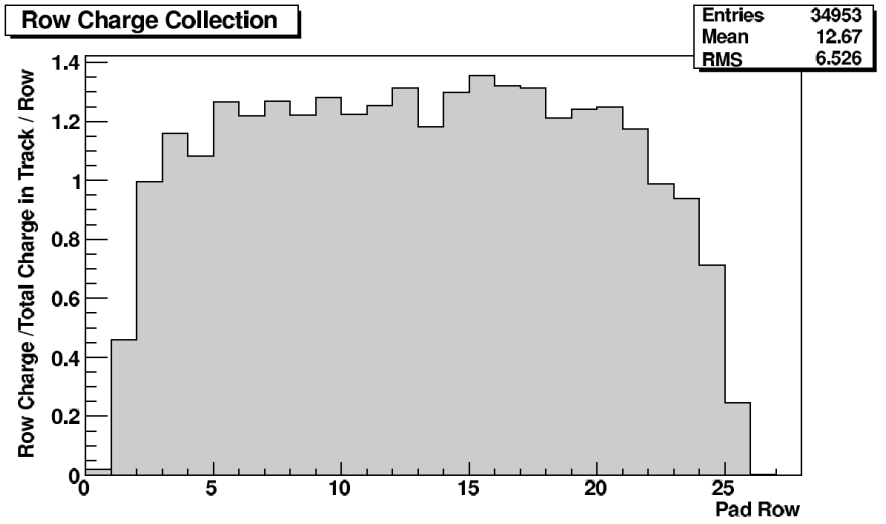
- High voltage
  - Insulation between HV and the pads
    - Gluing of the ceramics onto the board
  - Trips destroyed GEM sectors
    - Protective resistors too far from the GEMS
    - Additional energy stored in the cable

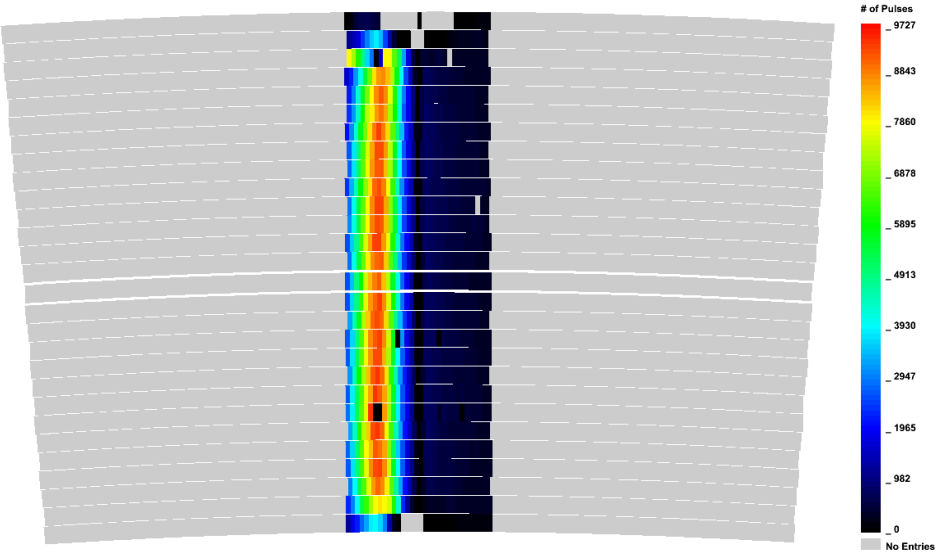




Problems Observed

- Reduced efficiency on the pads at the edge of the board
- Field distortions due to the gap between two modules





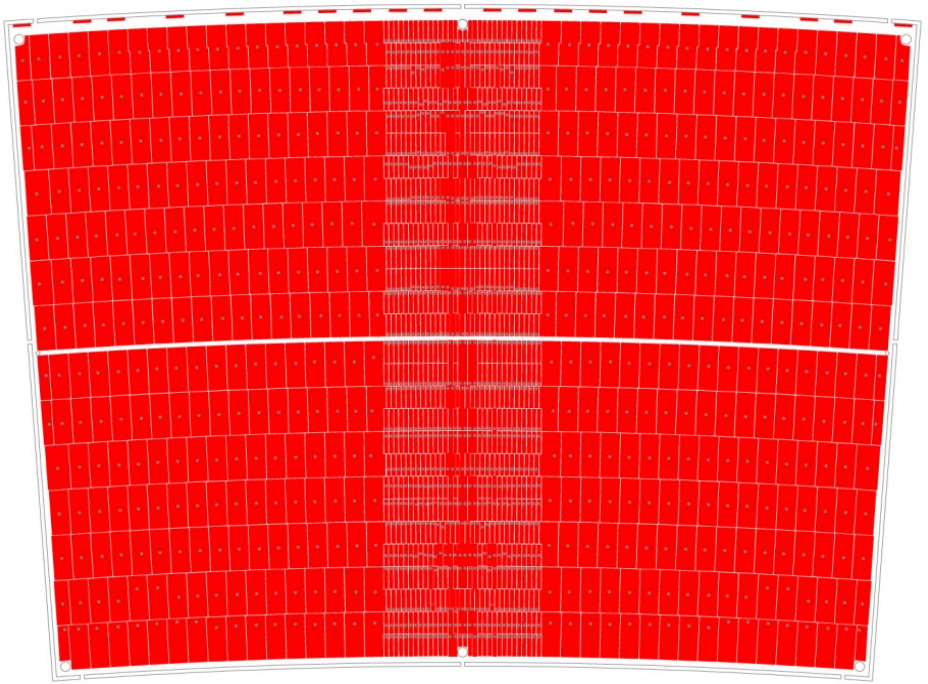
Number of reconstructed pulses

Improvements for the new Module

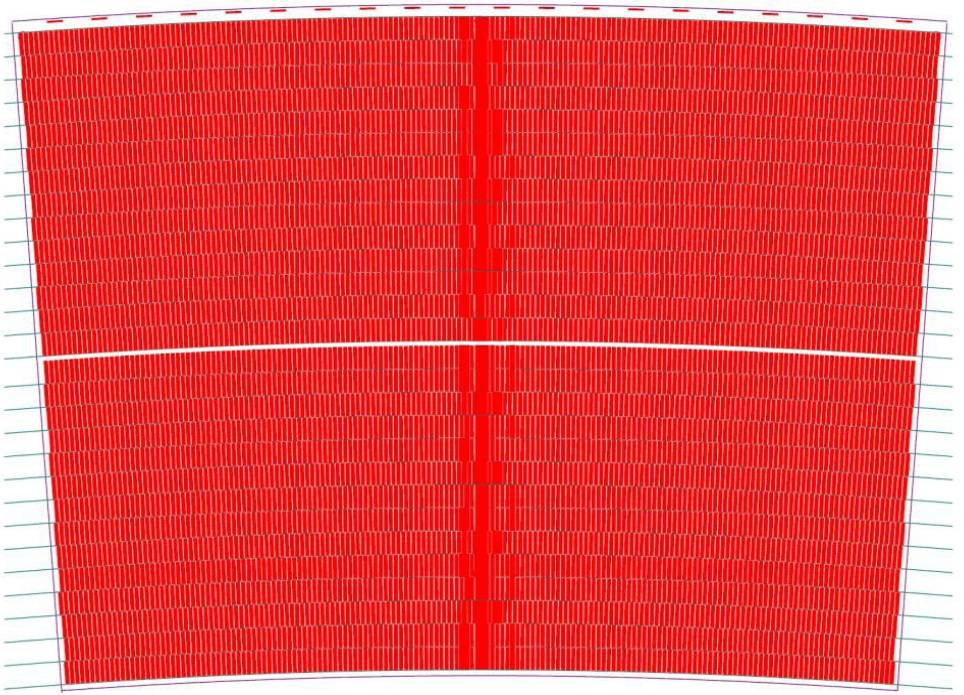
- Full sensitivity
- High voltage distribution
- Reduction of field distortions
- More defined production process
- Enhancement of the GEM flatness?

Full Sensitivity

- 1000 readout channels
- Central tracks at full resolution



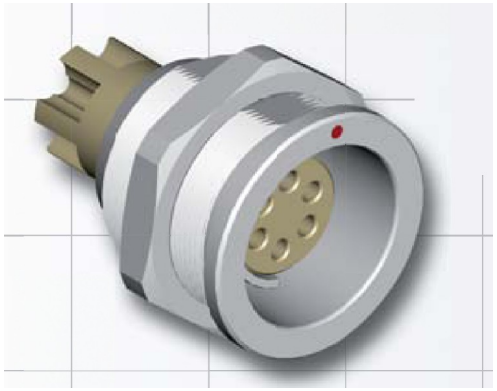
- 5000 readout channels
- Complete coverage of small pads



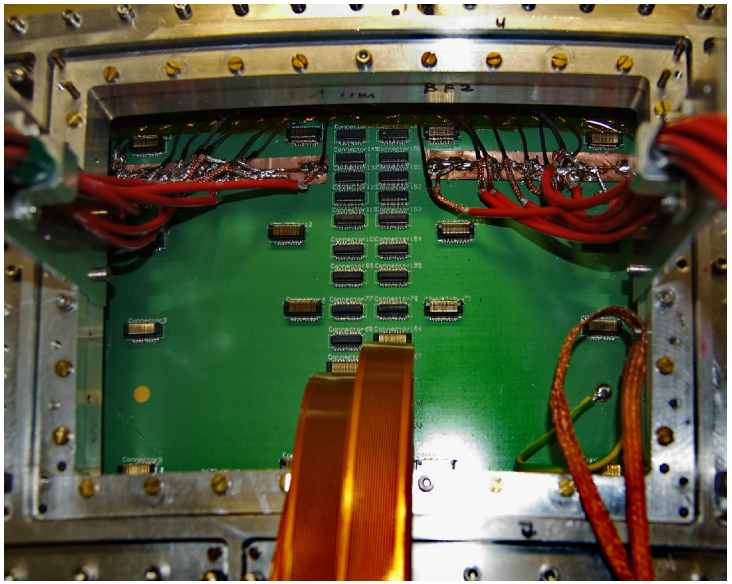
Designed by Jochen Kaminski at Bonn for Terascale Alliance

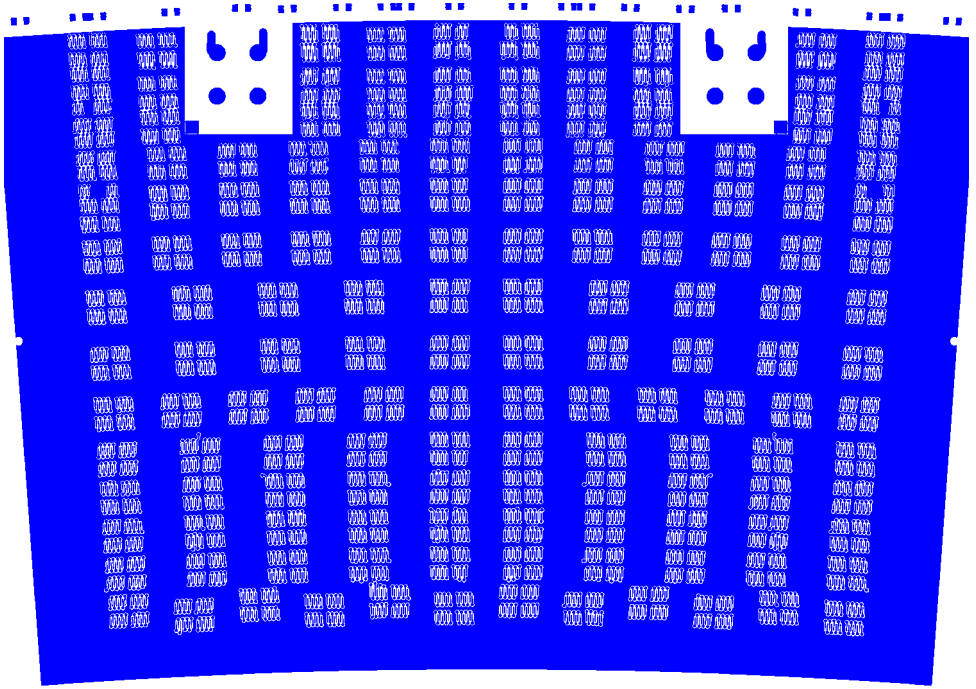
High Voltage distribution

- Two 4-pin high voltage connectors
- SMD protective resistors on the board
  - Reduce energy released during discharges



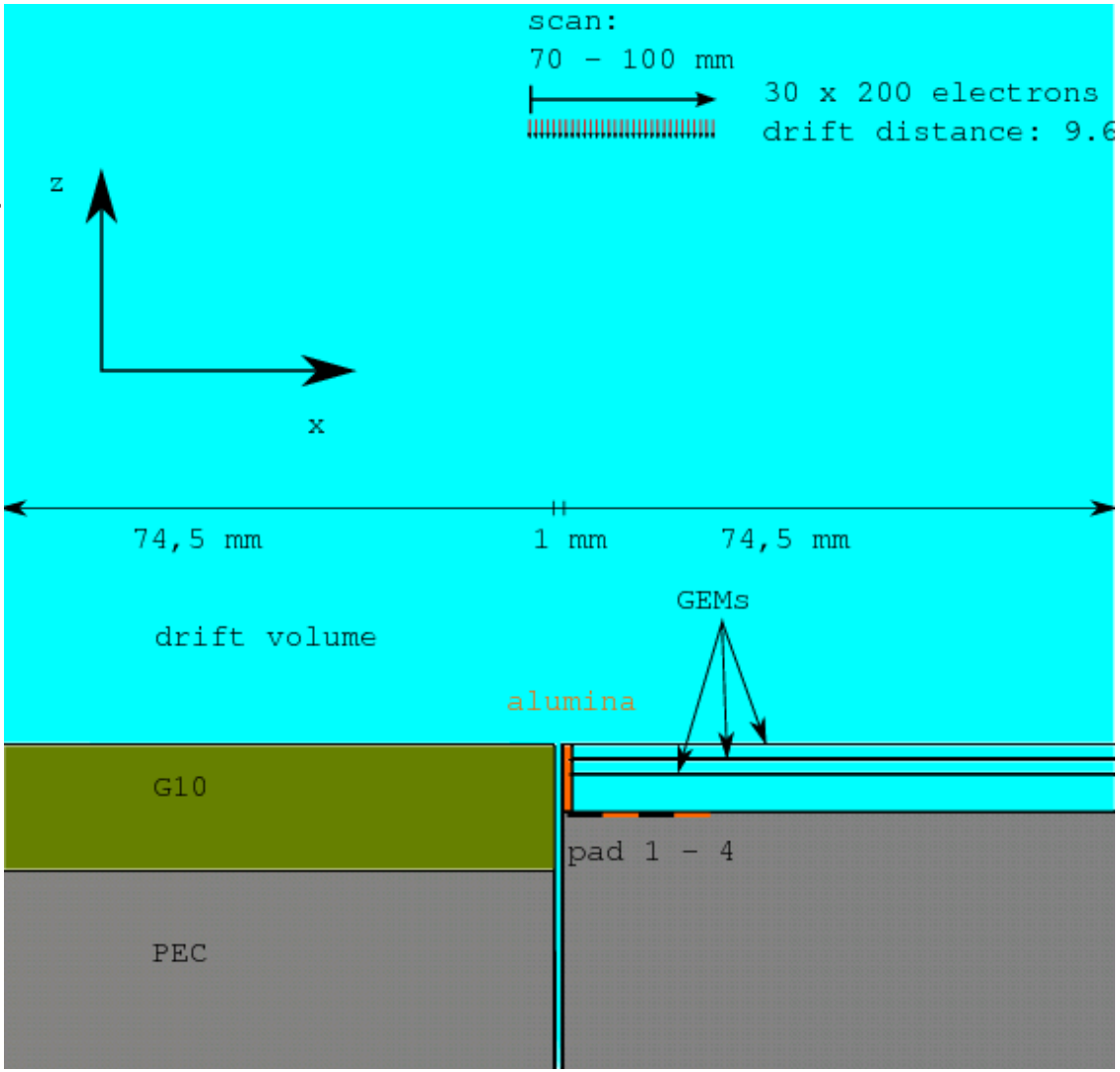
Source: Fischer Connectors





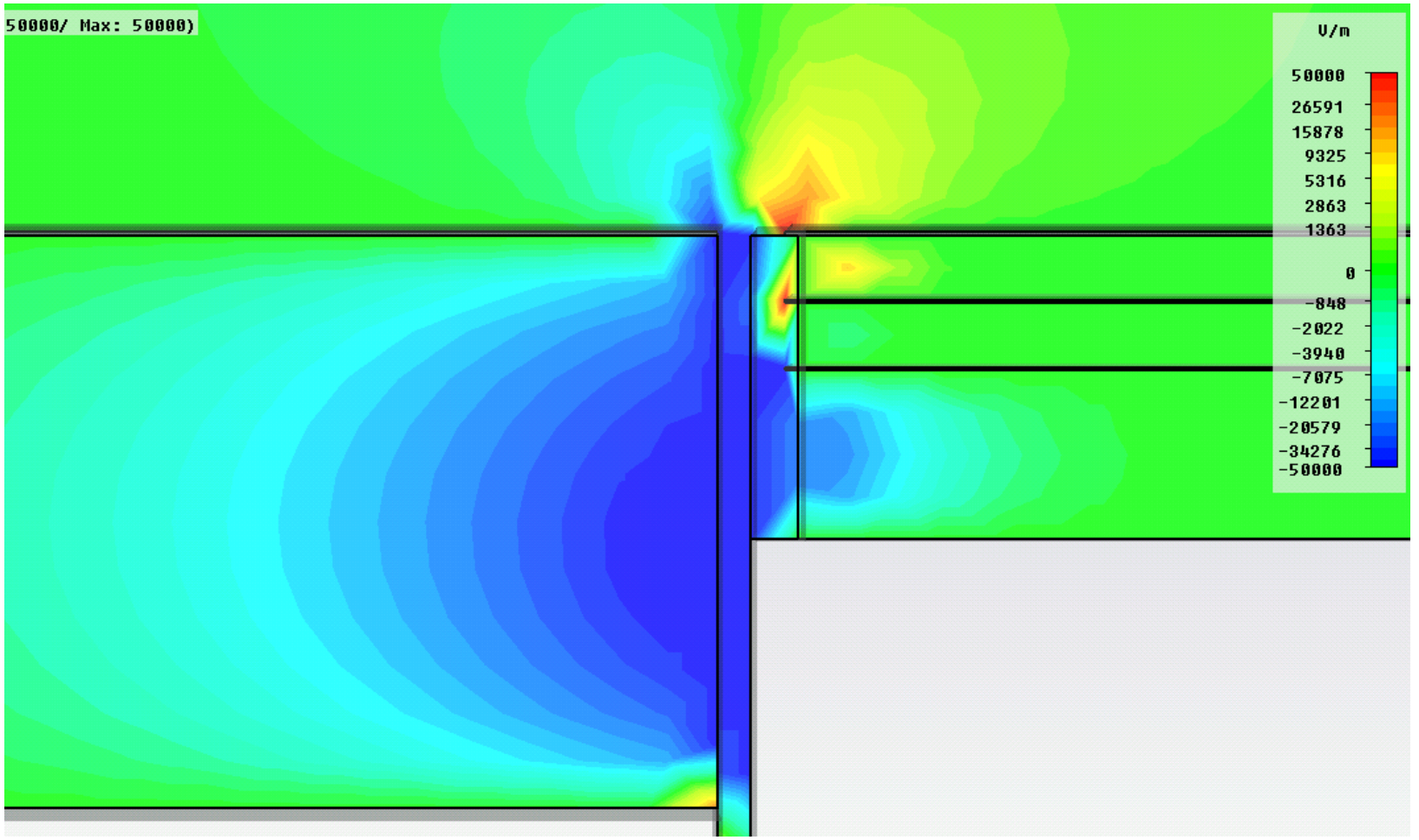
Simulation of Field Distortions

- Performed by Klaus Zenker
- Field distortions at the gap between two modules
- Electrostatic simulation with CST
- Garfield++ simulation of the electron drift



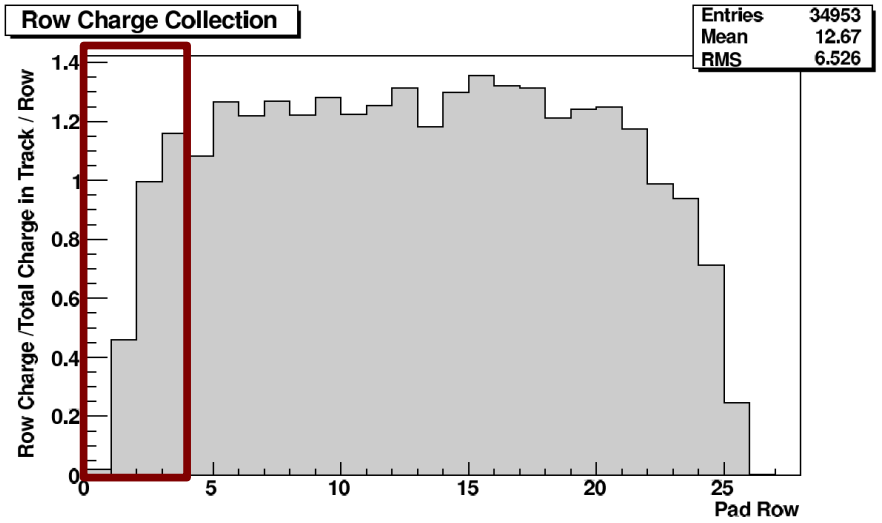
Field Distortions

- Horizontal E-field at the gap between dummy module and DESY module
- Large fluctuations causes electrons to drift towards the gap

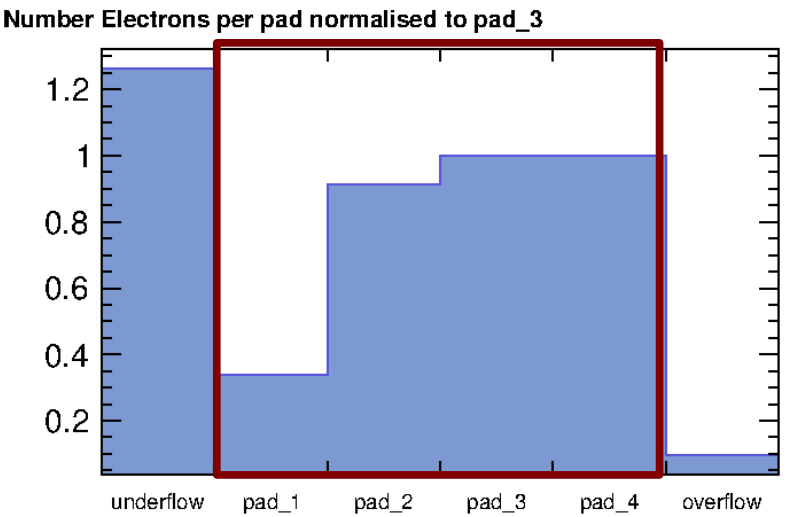


Simulation and Measurement

- Electron position above the top GEM
- Count number of electrons at the pad positions
- Underflow represents electrons which missed the board
- Overflow are all electrons at higher row numbers



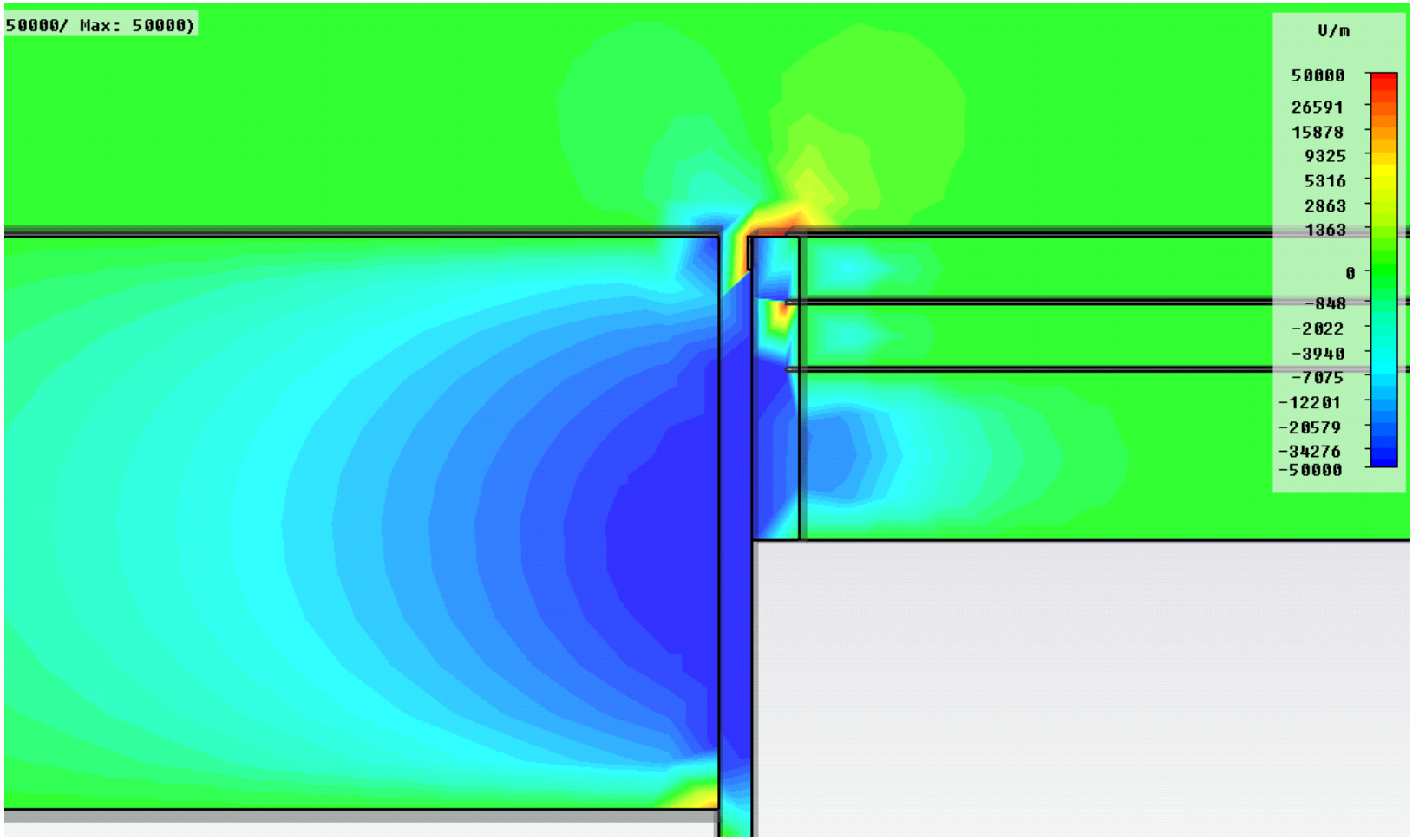
Measurement



Simulation

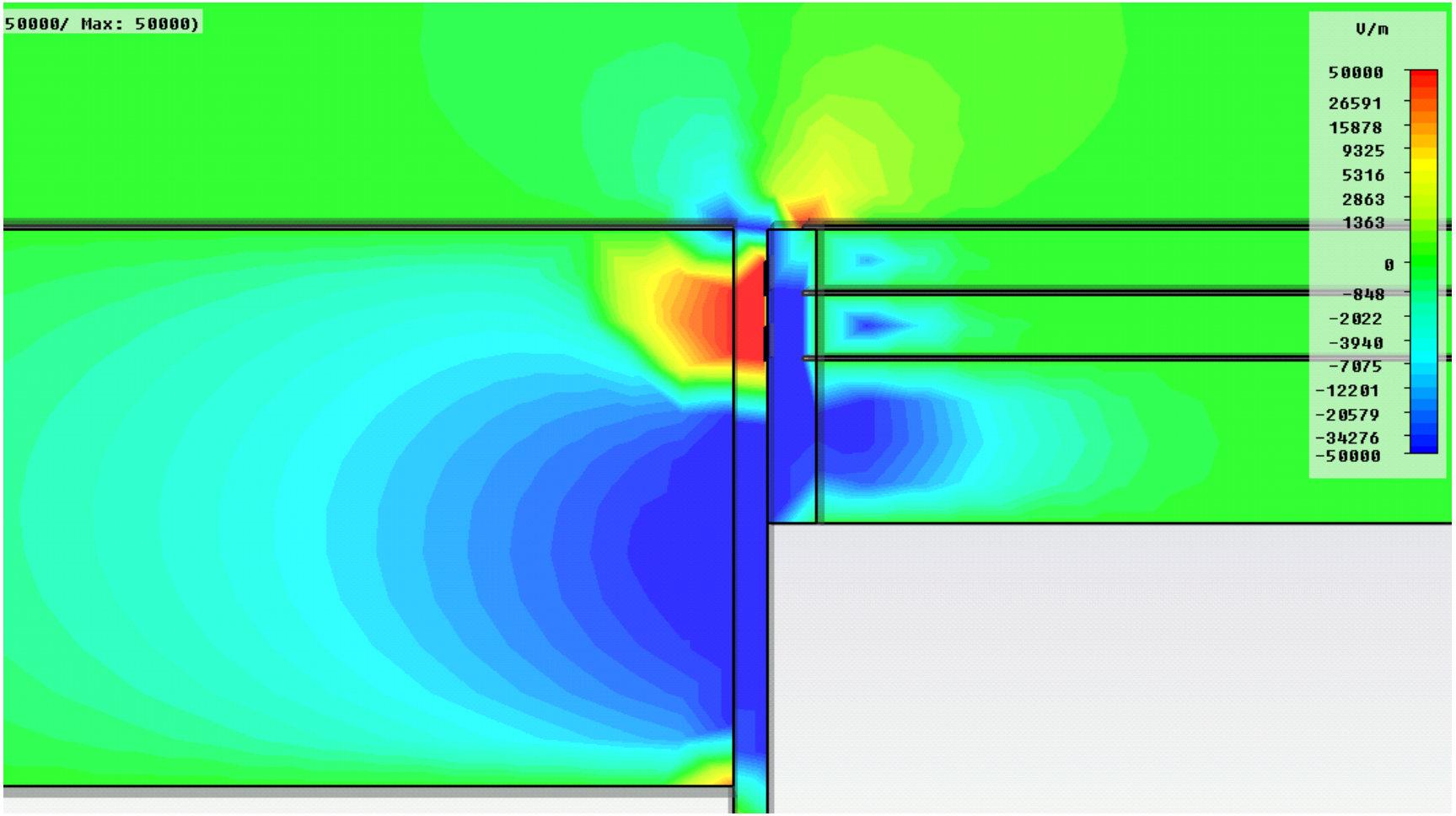
Field Shaping

- Additional strip on the ceramic frame
  - Same potential as top GEM



Field Shaping

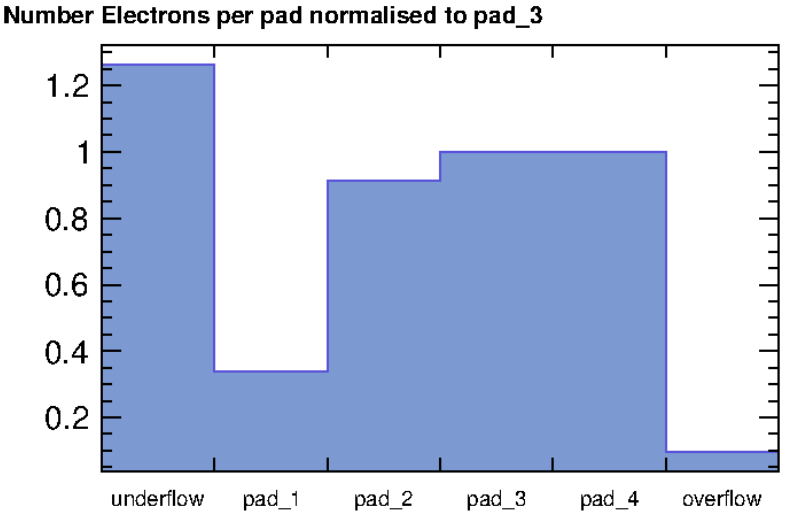
- Additional two strips on the ceramic frame

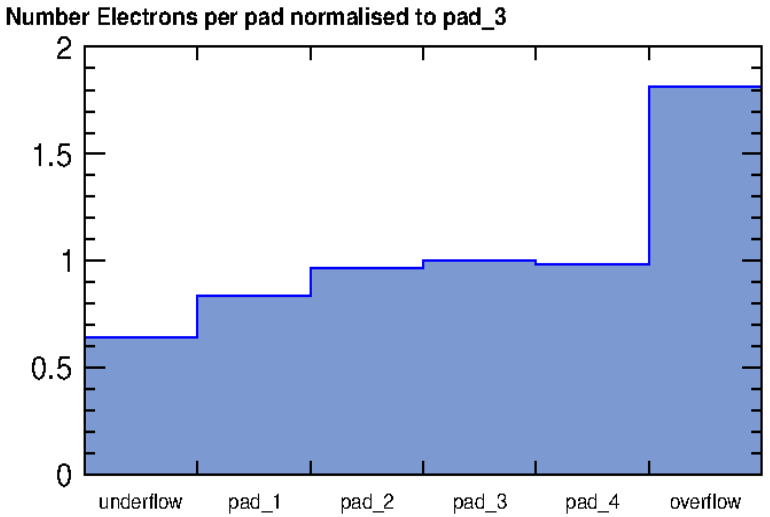


Results of the Simulation

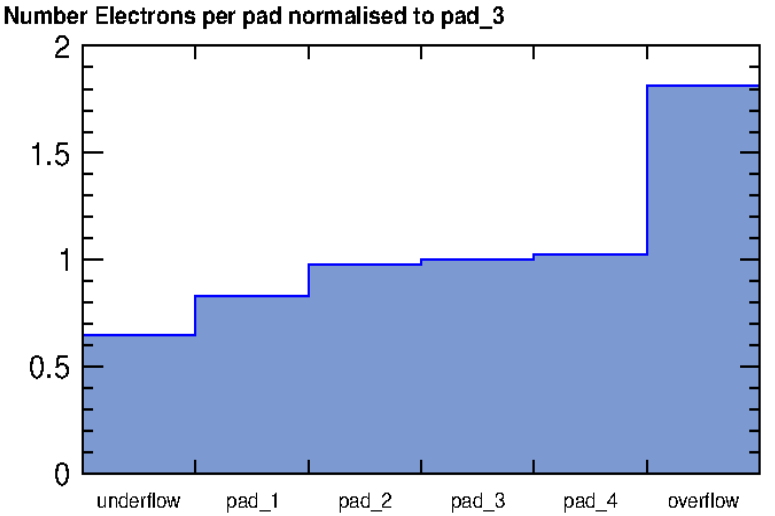
- Both option show improvements
- Further analysis with two real modules

No field shaping





One strip



Two strips

Status of the new Module

- Nearly everything is ordered
  - HV cable, pad board, back frame, ceramics
- Or arrived
  - GEMs, HV connectors
- Todo: testing the single components
- Todo: testing assembled module
  - GEM flatness
  - Gain uniformity

- Go to the test beam at the end of summer with three modules

Conclusion and Outlook

- First iteration of a triple GEM module with pad readout was tested successfully
- Problems of the design were identified
  - Design changes for a new module were developed
- Ongoing analysis shows reasonable results

Outlook

- A new module is in production
- Late summer test beam with three modules