Laser data analysis

Klaus Zenker

April 23, 2014

Reminder on the measurements done with the laser setup

November 2013:

- 3 DESY grid-GEM modules
- ALTRO readout
- Central module fully equipped
- In the end one module broke

⇒ We tried another setup with remaining two modules

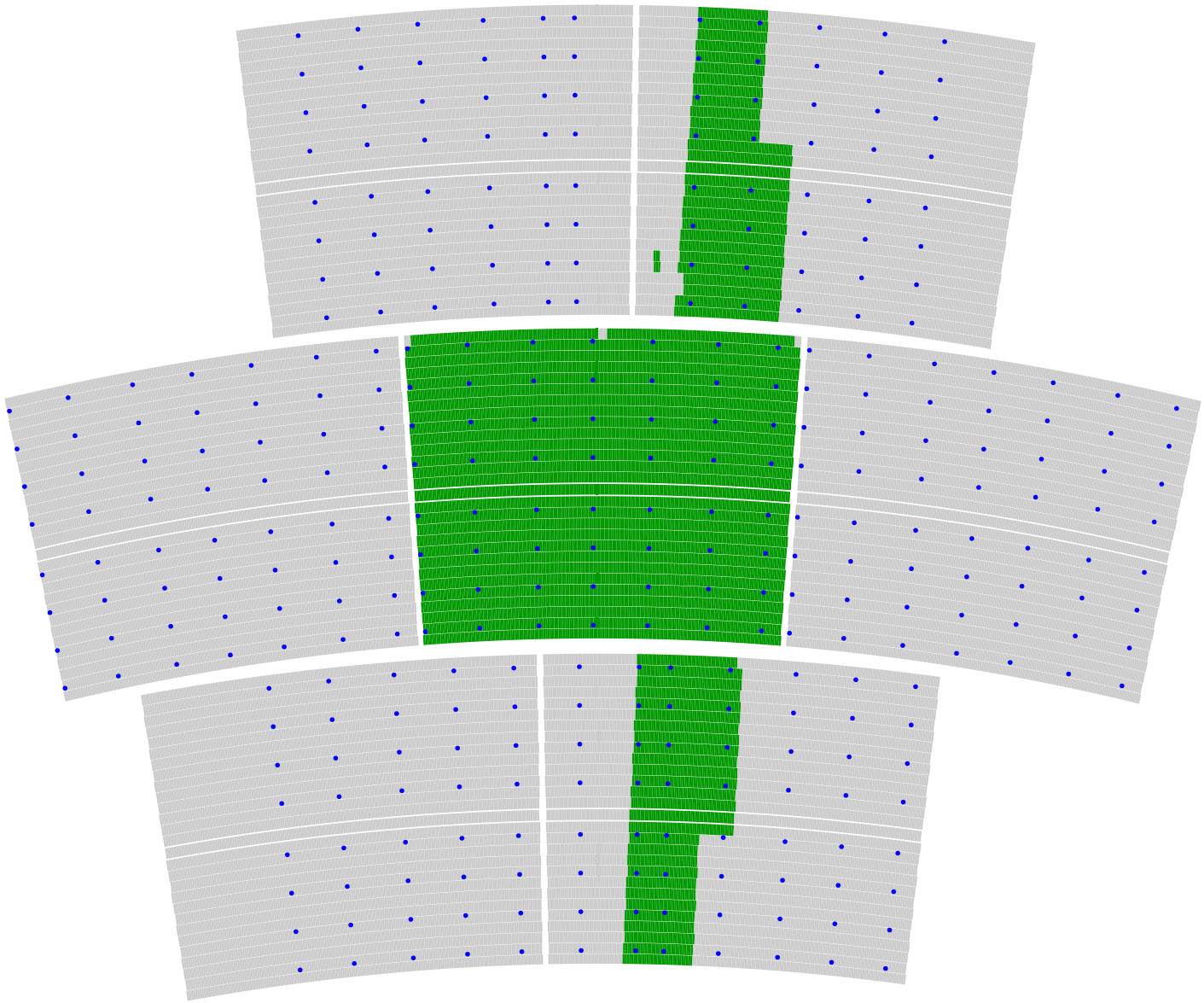
- One broke immediately ⇒ we stopped the test beam

February 2014:

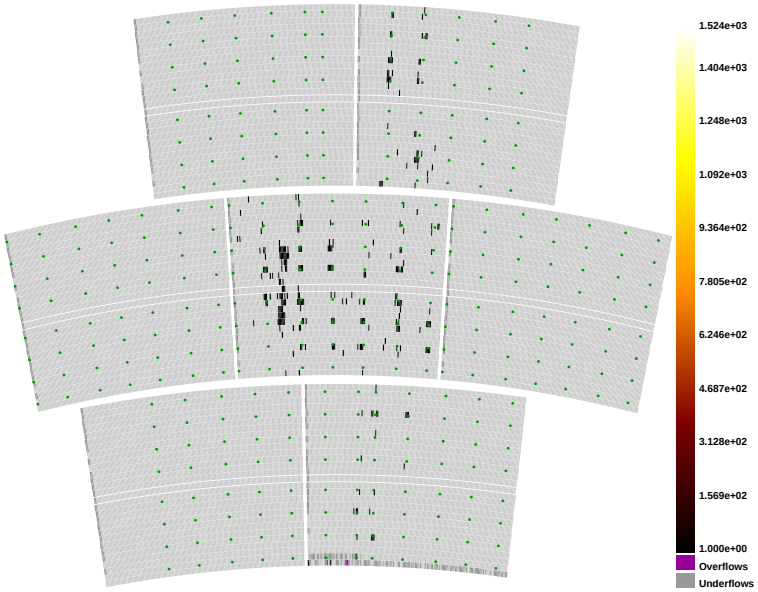
- 6 MicroMegas modules (with 2 ASICs not working)
- No further problems during the test
- Signal strength is better than with the DESY grid-GEM modules

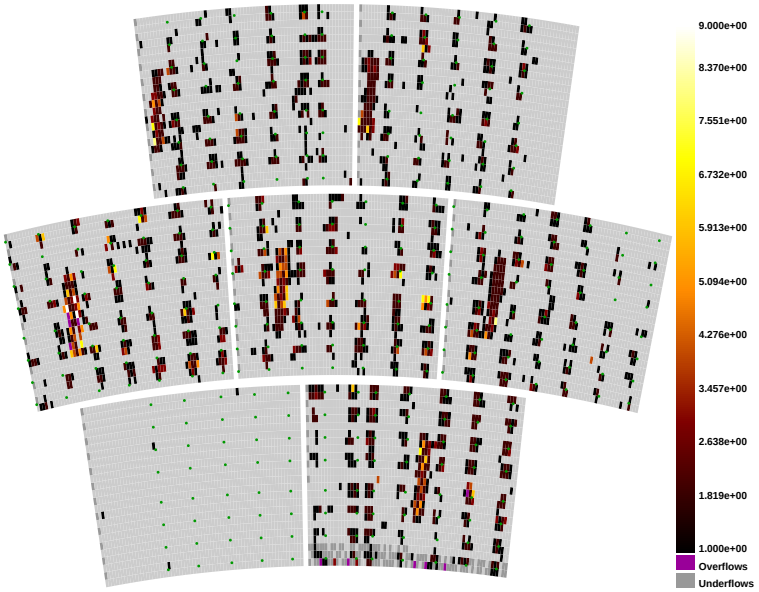
⇒ Higher gain could be applied

DESY grid-GEM channel mapping setup 1

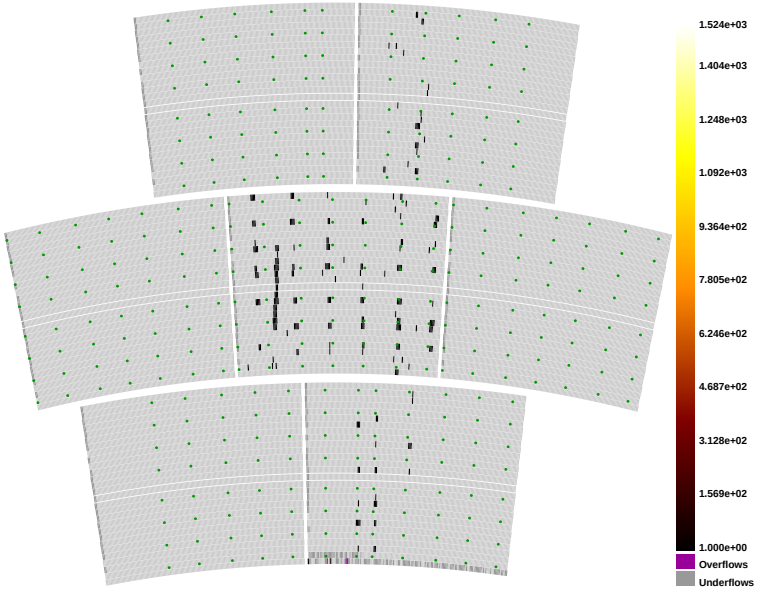


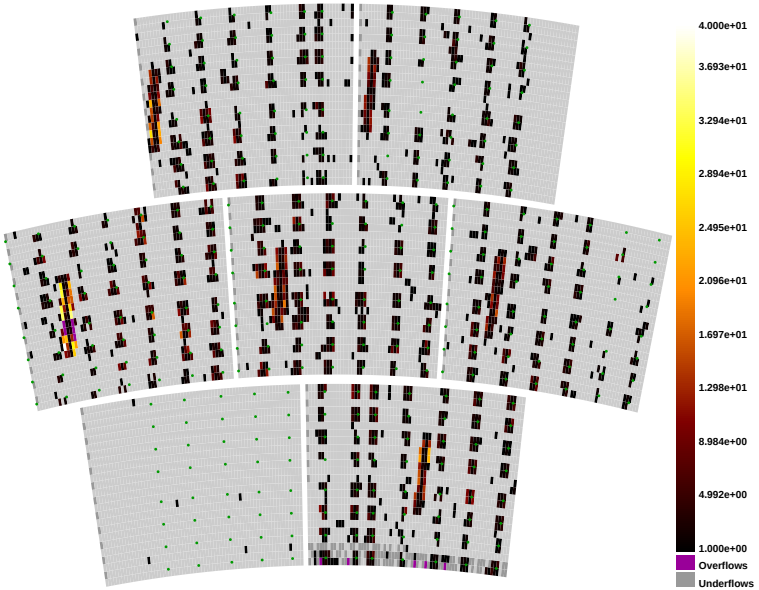
Single laser shot ($E_{\mathrm{drift}} = 240\,\mathrm{V/cm}$)





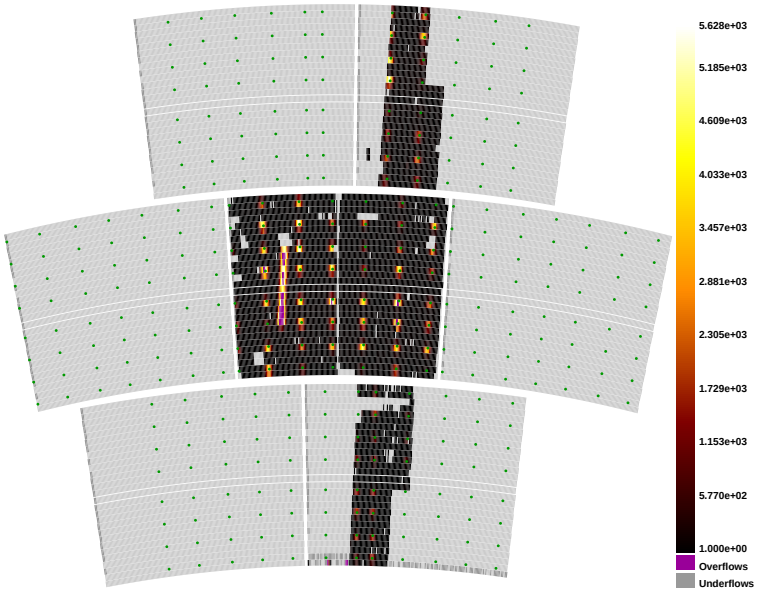
$B = 0\,\mathrm{T}$

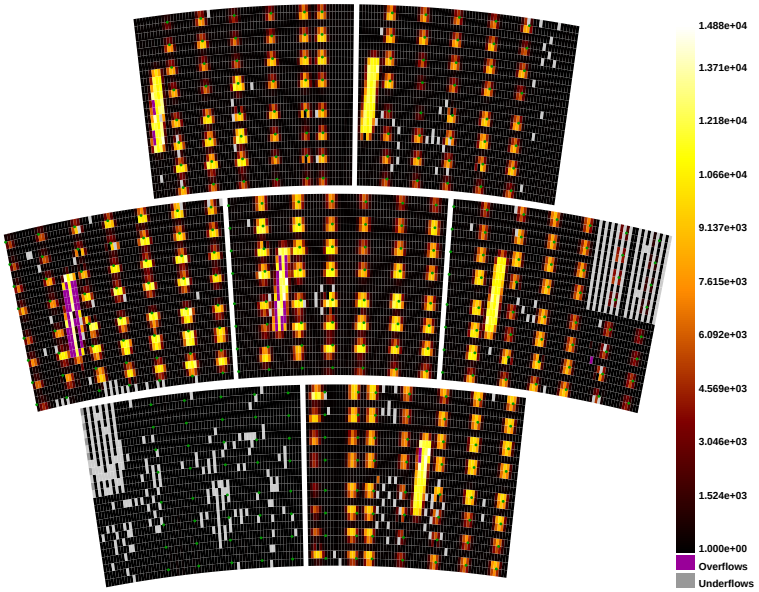




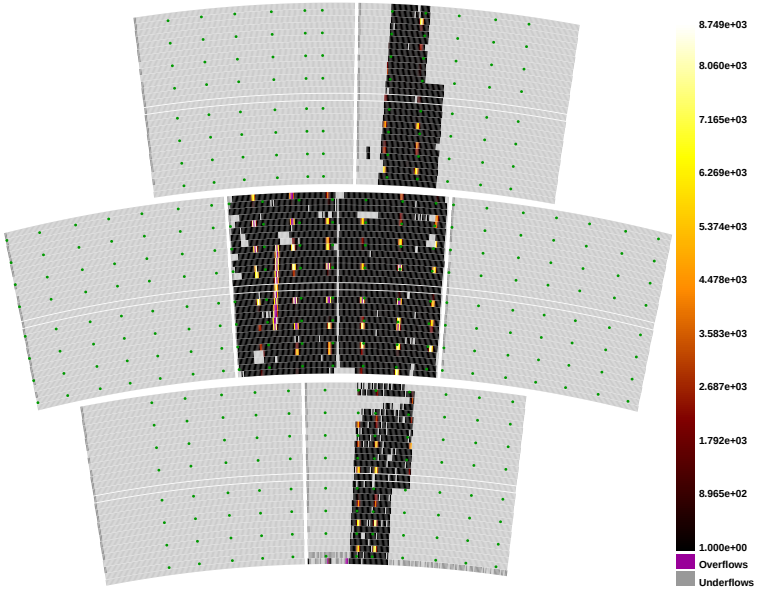
$B = 1\,\mathrm{T}$

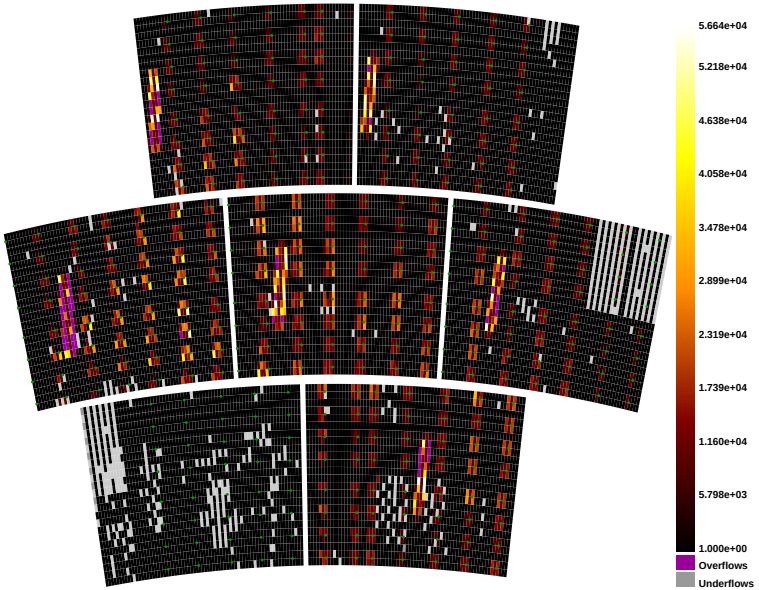
Single laser run (10000 events, $E_{\mathrm{drift}} = 240\,\mathrm{V/cm}$)





$B = 0\,\mathrm{T}$





$B = 1\,\mathrm{T}$

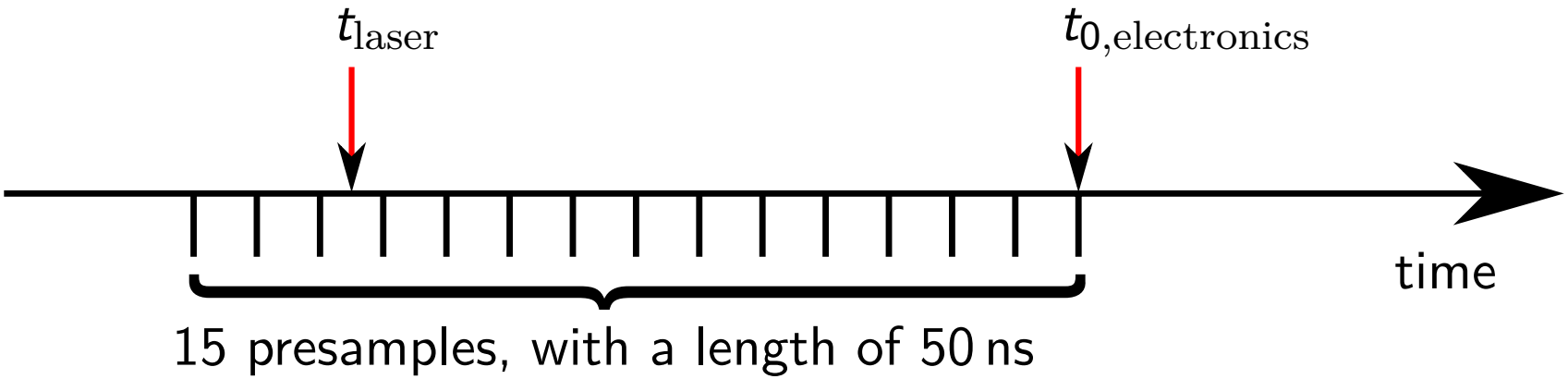
Corrections of the drift time

MAGBOLTZ:

- T2K gas consists of: 95 % Ar, 3 % CF_4,2 % iC_4H_{10}
- But: additional gas components influence gas properties
- During laser test (GEM): 135 ppmv H_2O, 135 ppmv O_2

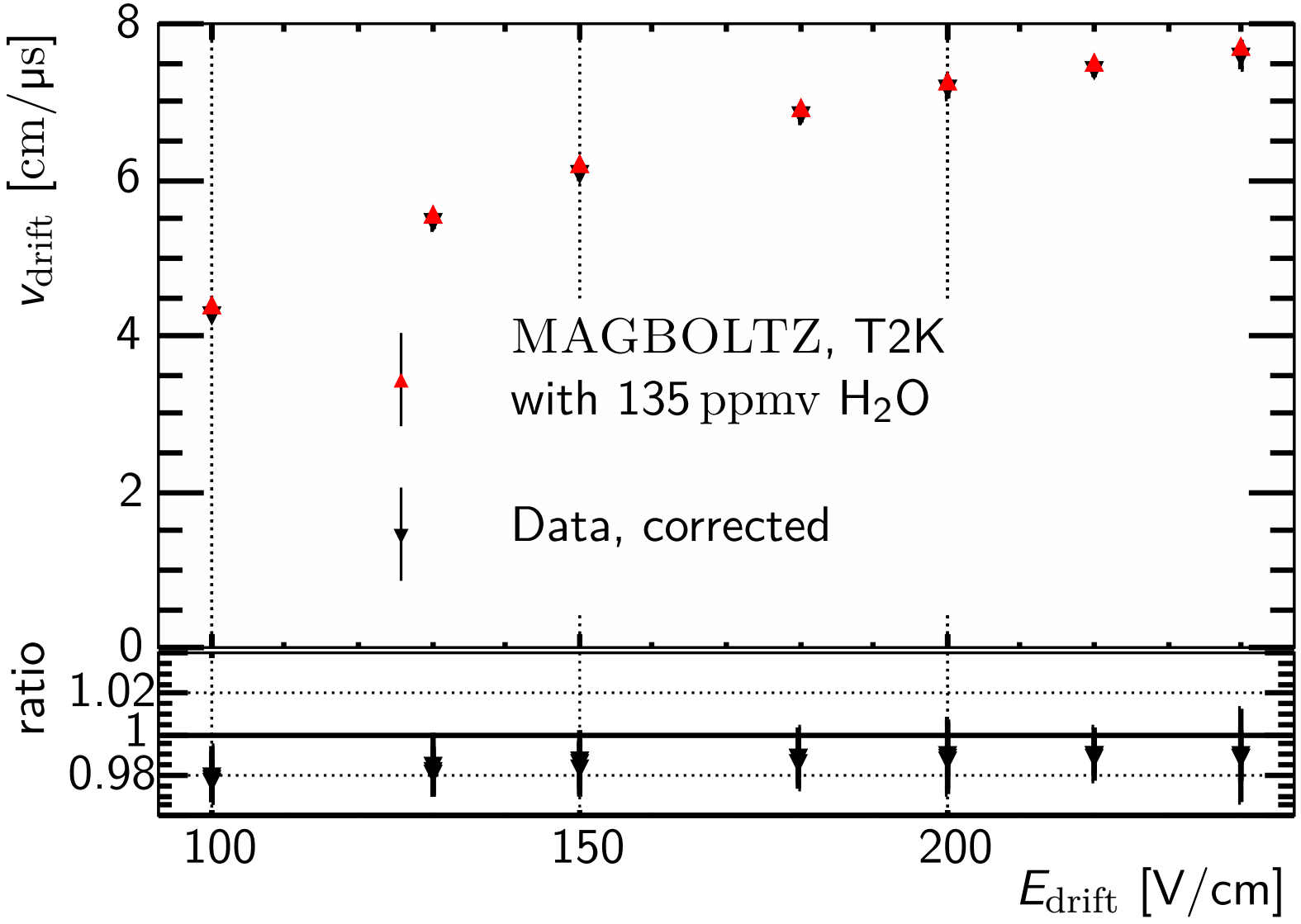
Pulse time:

- Correct for cables and electronics delay
- Correct for the presamples ⇒ additional 0.75 µs



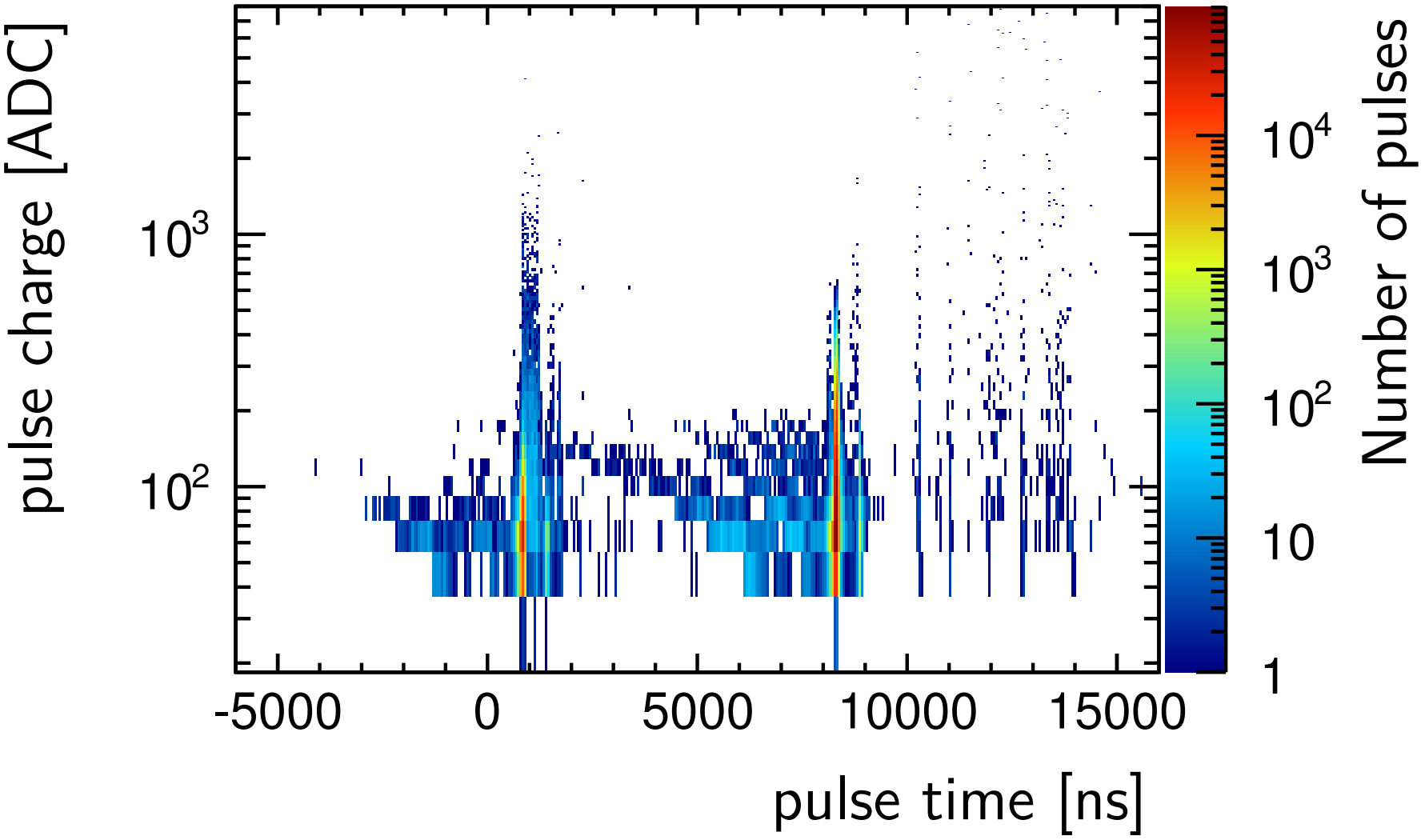
Driftgeschwindigkeit für T2K mit DESY Modulen

time shift: 17 time bins



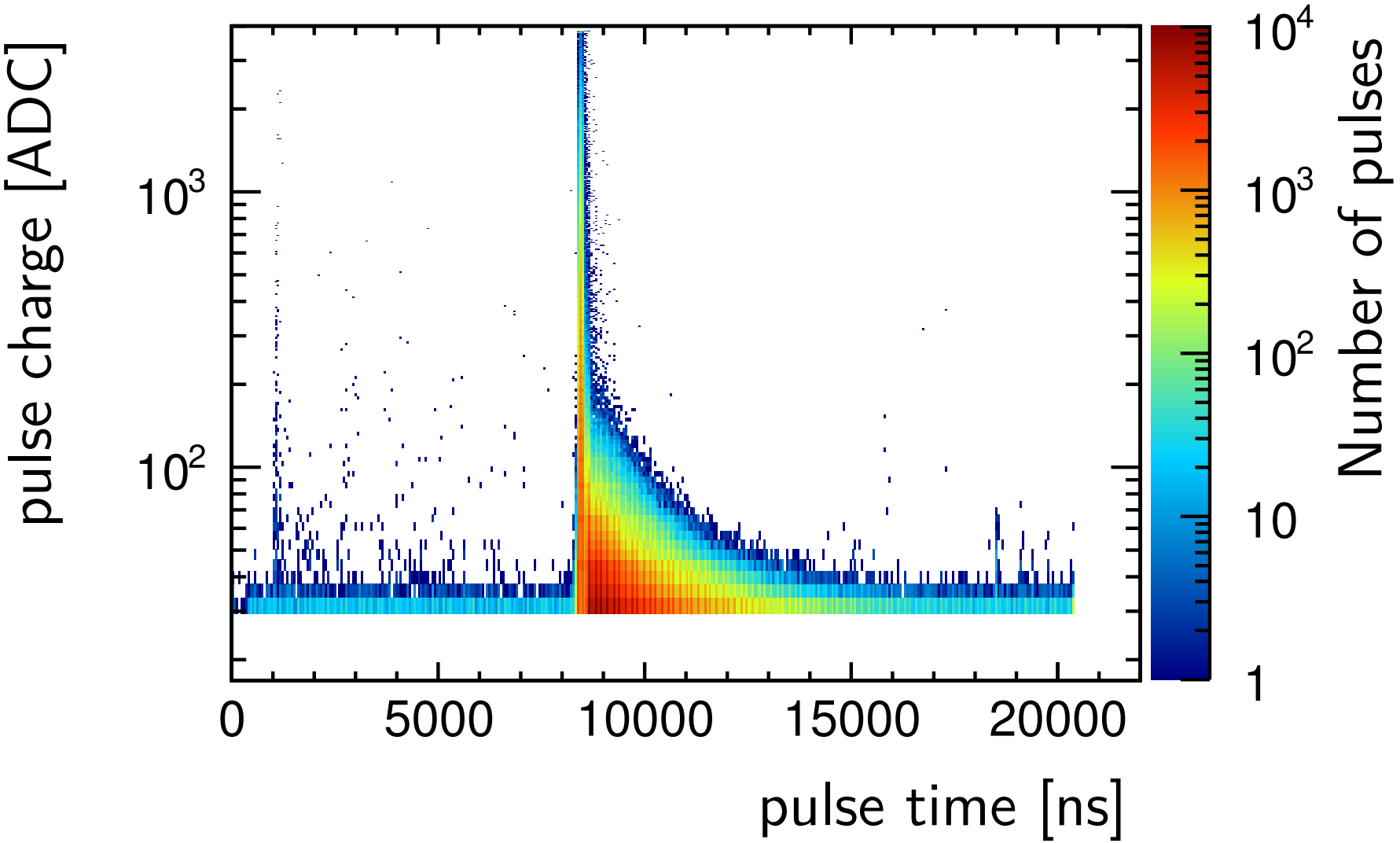
Reconstructed pulse charge vs. time

DESY Modul, $B = 1\,\mathrm{T}$, $E_{\mathrm{drift}} = 100\,\mathrm{V/cm}$



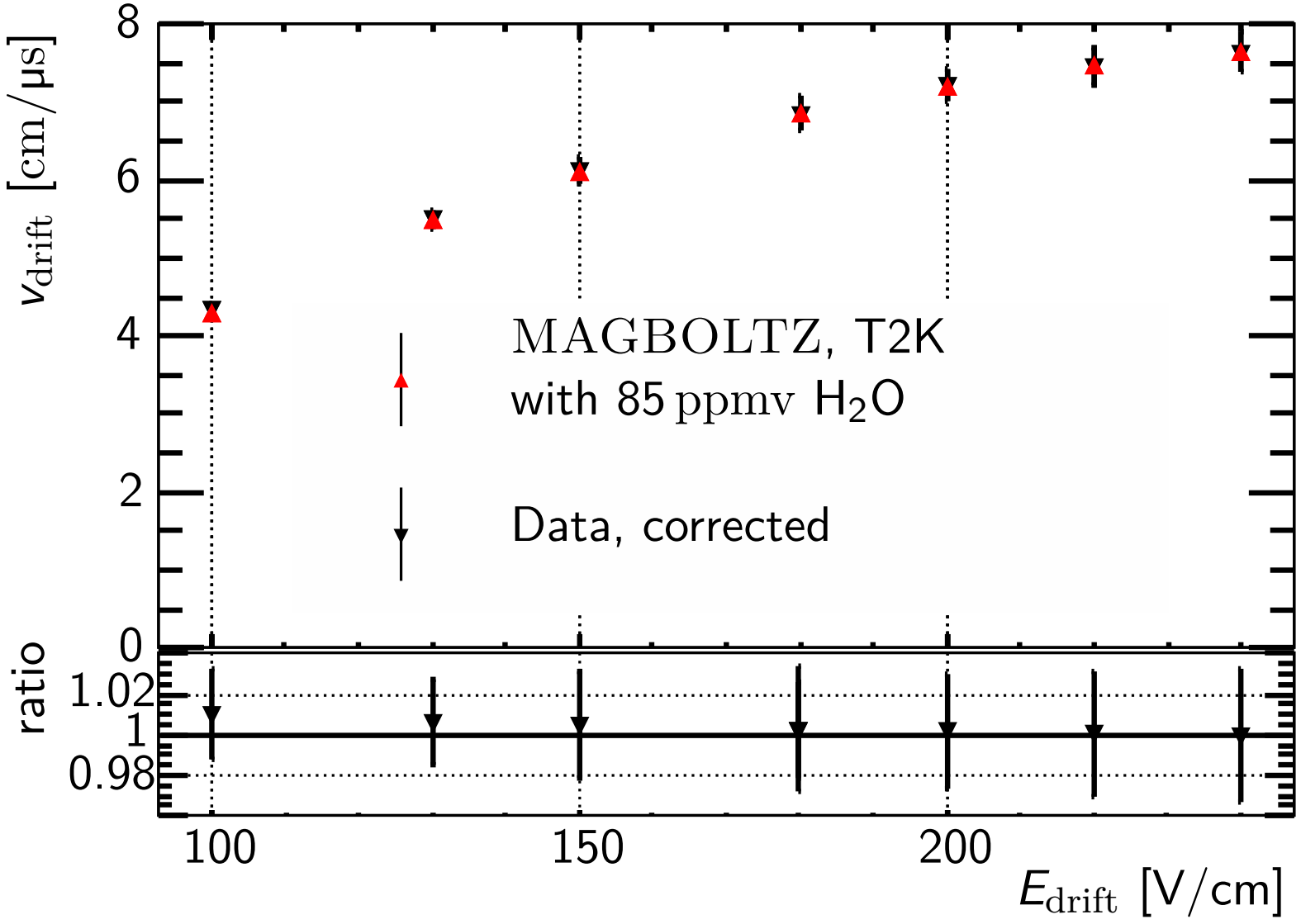
Reconstructed pulse charge vs. time

MicroMegas Modul, $B = 1\,\mathrm{T}$, $E_{\mathrm{drift}} = 240\,\mathrm{V/cm}$



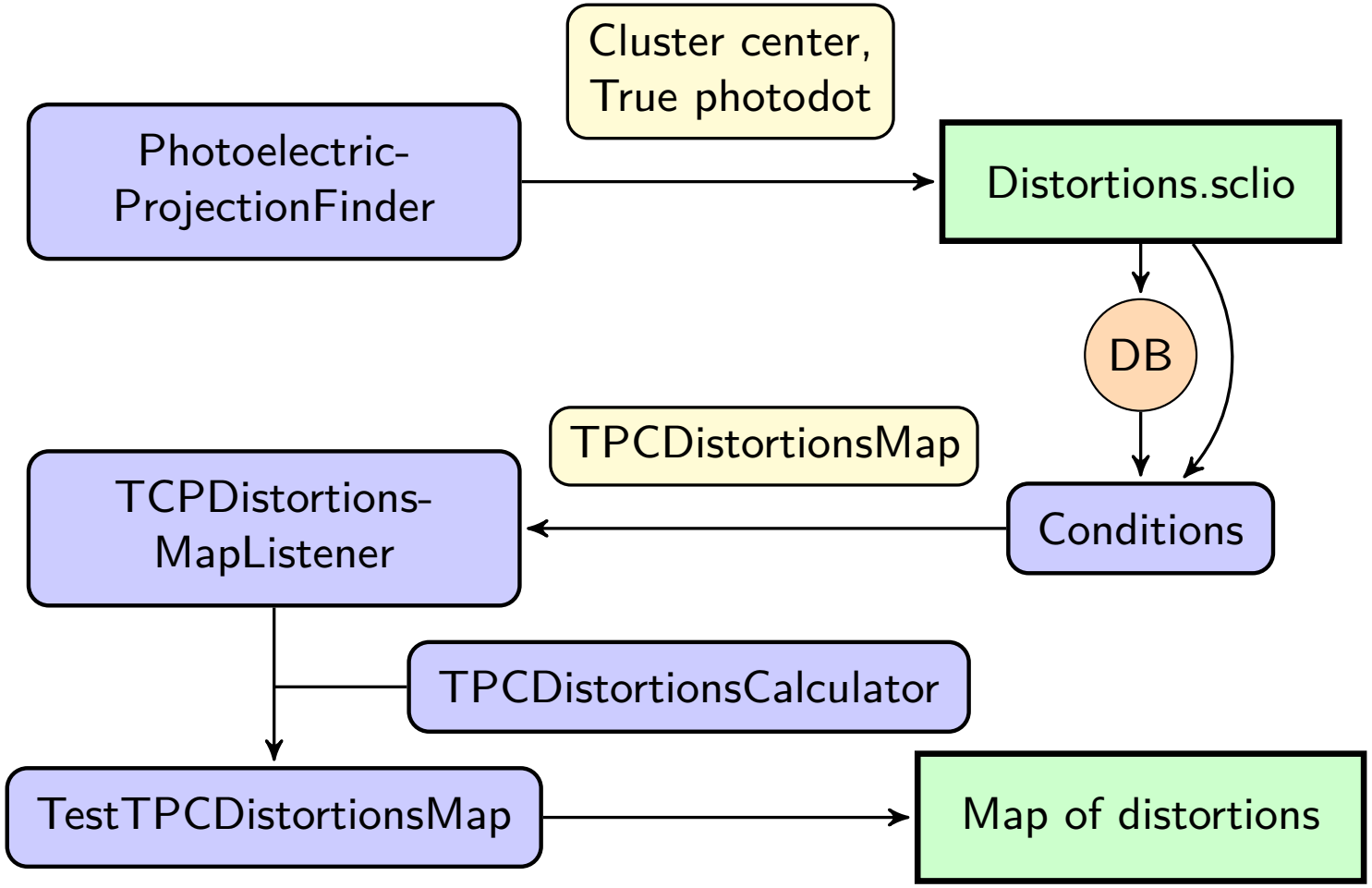
Driftgeschwindigkeit für T2K mit MicroMegas Modulen

With additional charge cut: pulse charge > 200, time shift: 25 time bins



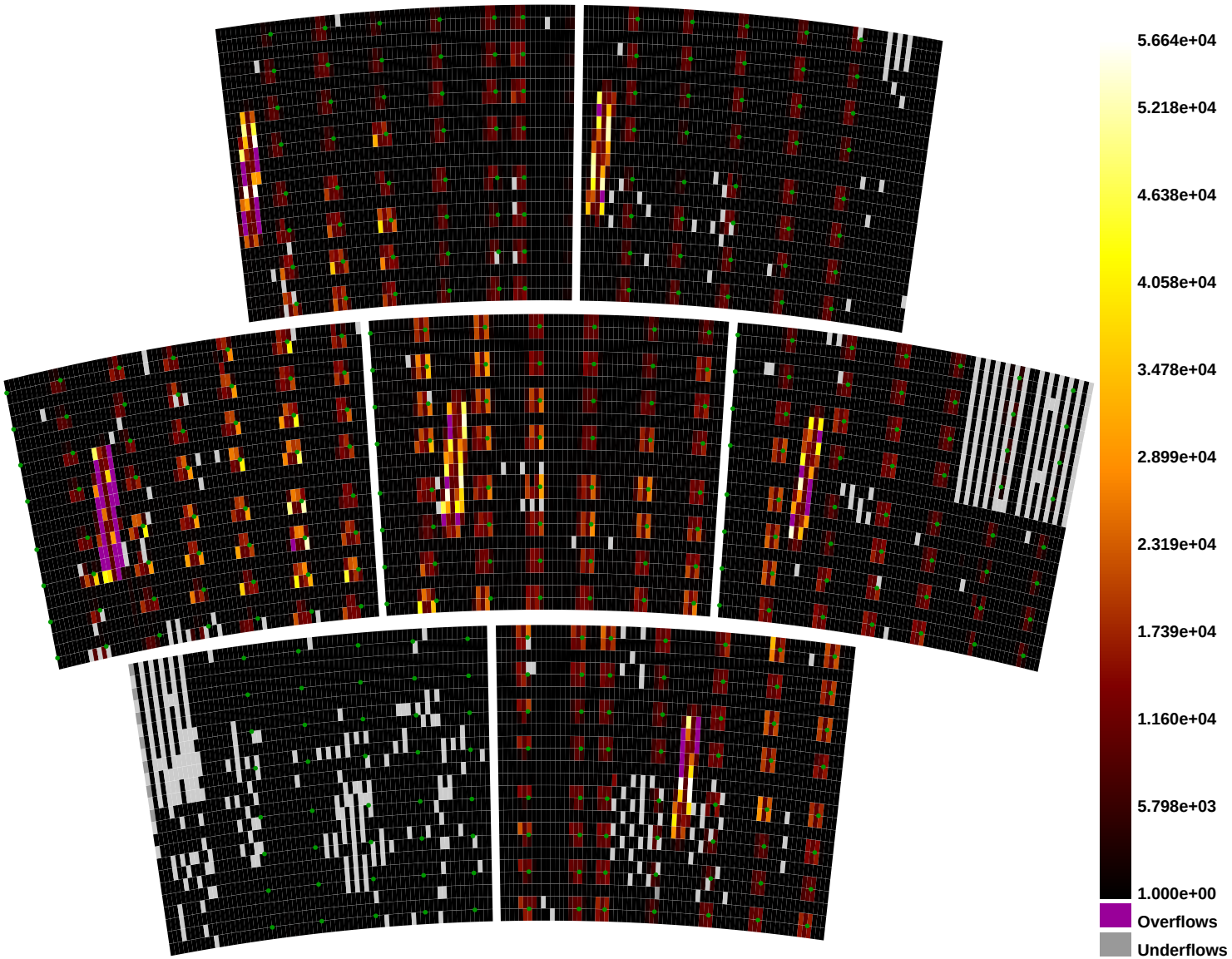
Field distortions in MarlinTPC

In order to reconstruct field distortions I use the following work flow:



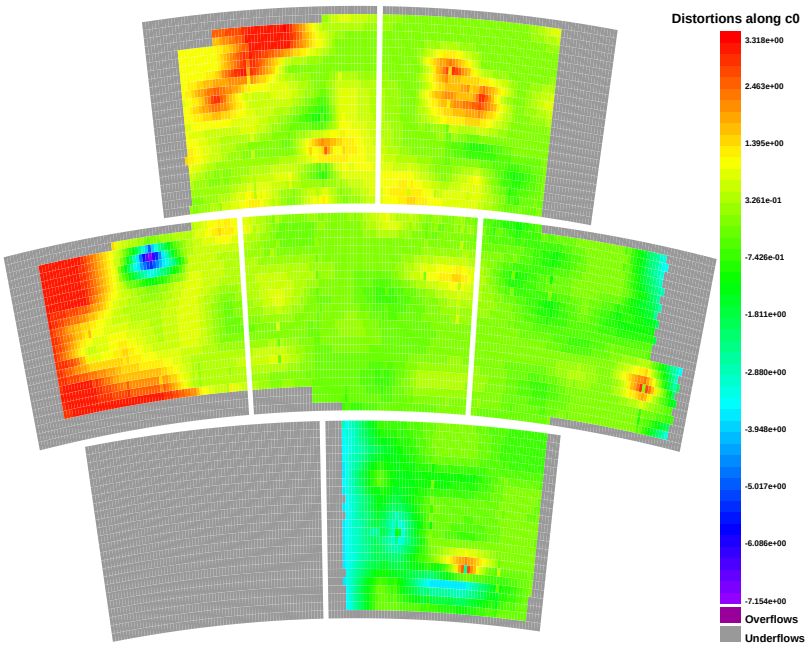
Pulse map for $B = 1\,\mathrm{T}$, $E_{\mathrm{drift}} = 240\,\mathrm{V/cm}$

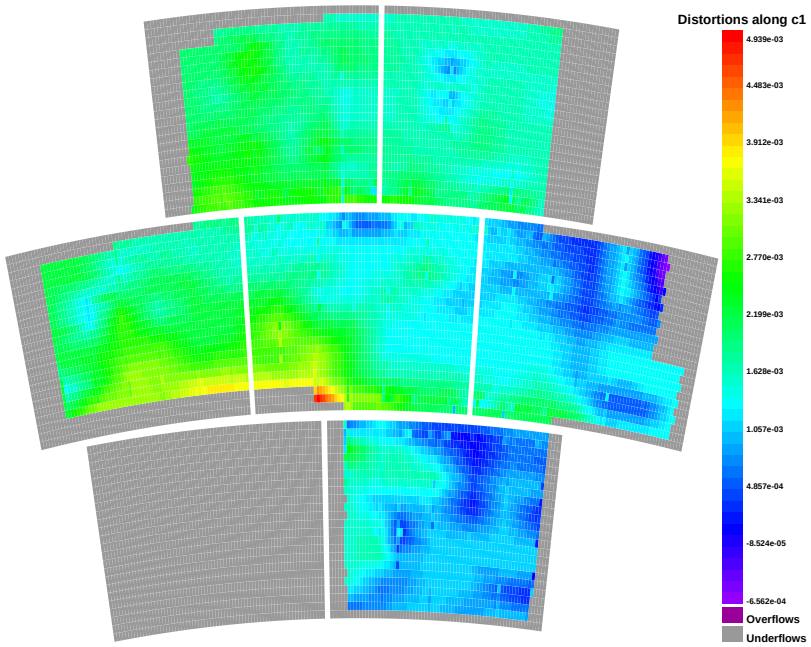
MicroMegas



Distortions map for $B = 1\,\mathrm{T}$, $E_{\mathrm{drift}} = 240\,\mathrm{V/cm}$

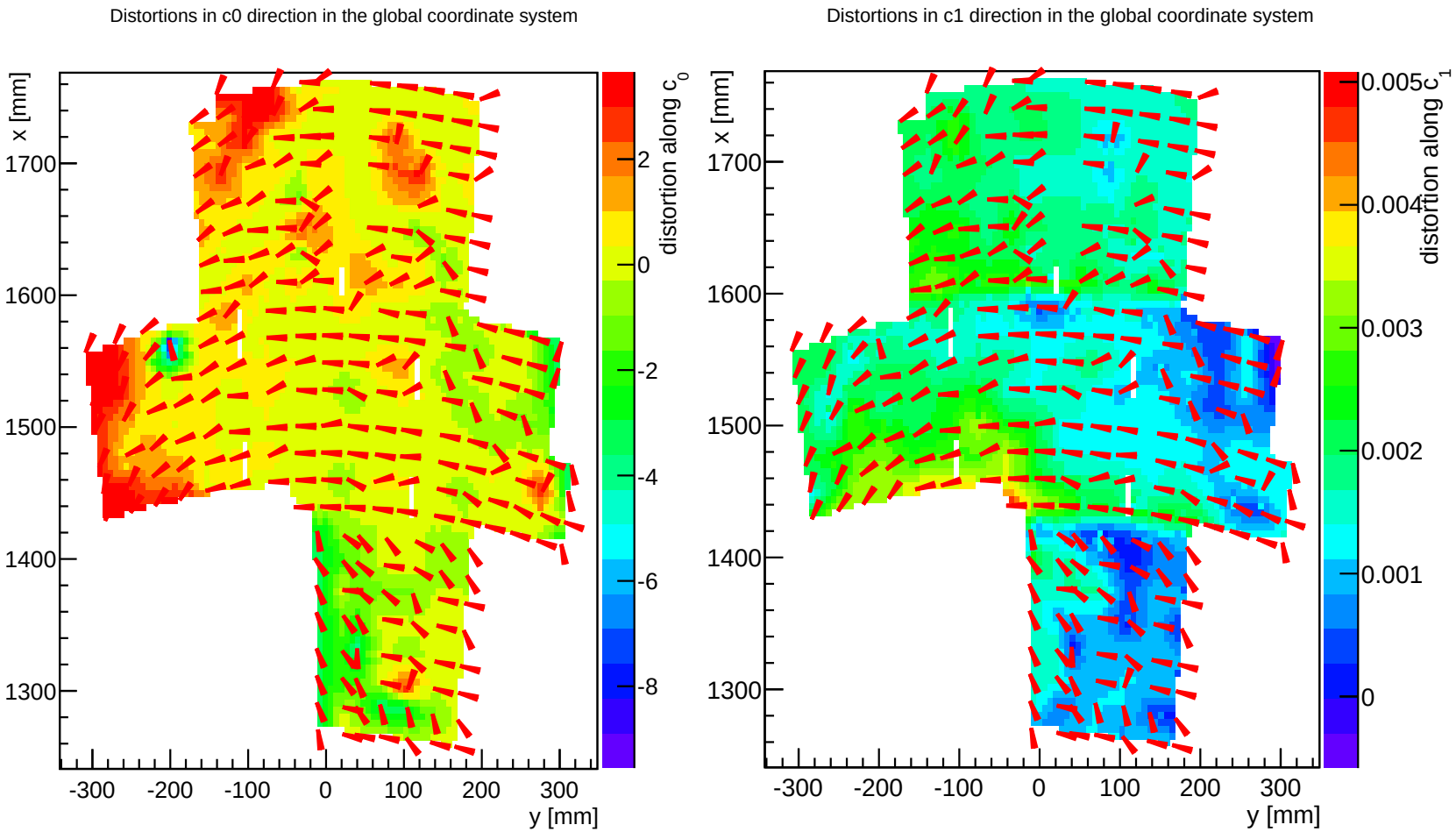
MicroMegas; $c_0 = r$ [mm], $c_1 = \varphi$ [rad]





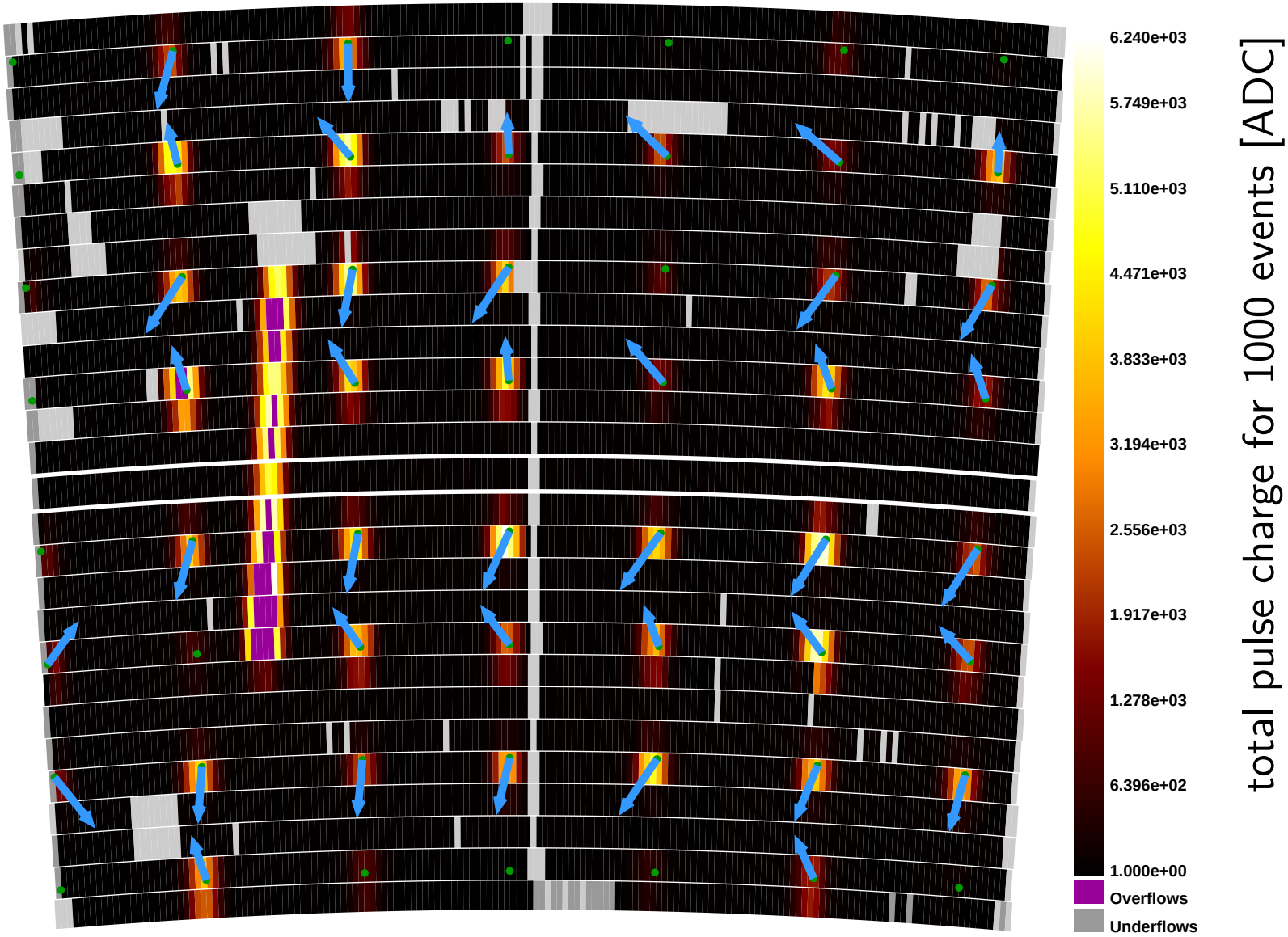
Distortions map for $B = 1\,\mathrm{T}$, $E_{\mathrm{drift}} = 240\,\mathrm{V/cm}$

MicroMegas; $c_0 = r$ [mm], $c_1 = \varphi$ [rad]



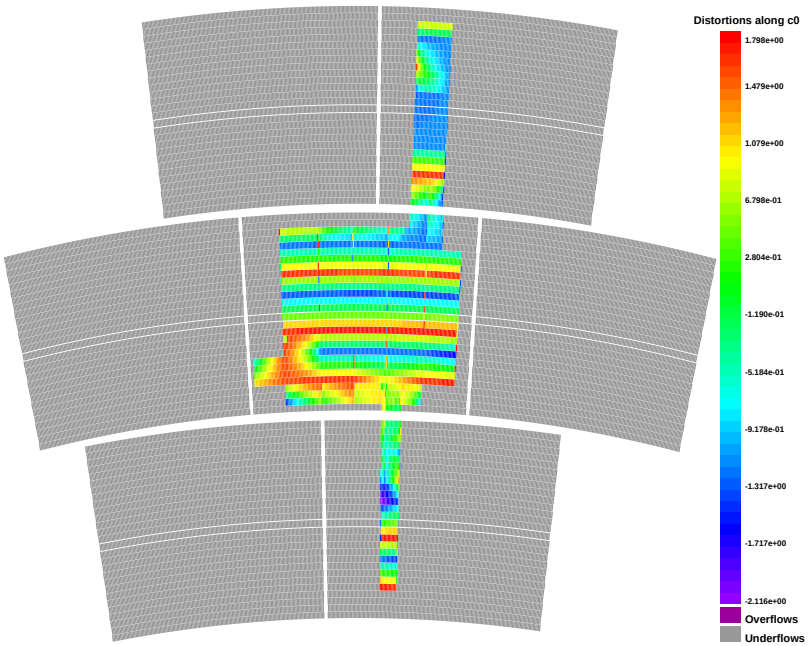
Central DESY GEM module

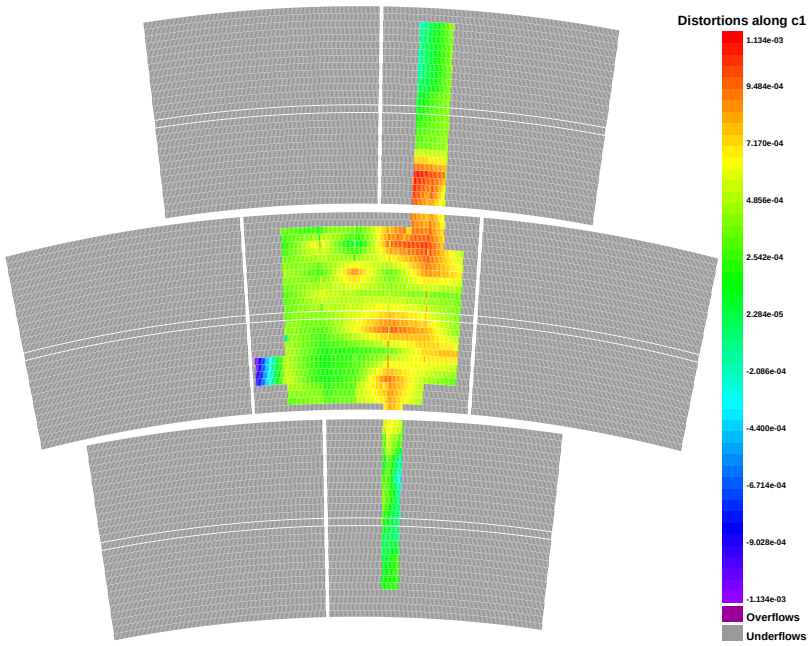
$B = 0\,\mathrm{T}$, $E_{\mathrm{drift}} = 240\,\mathrm{V/cm}$, Shift scaled by a factor 5, pads: $1,2 \times 5,7\,\mathrm{mm}^2$



Distortions map for $B = 0\,\mathrm{T}, E_{\mathrm{drift}} = 240\,\mathrm{V/cm}$

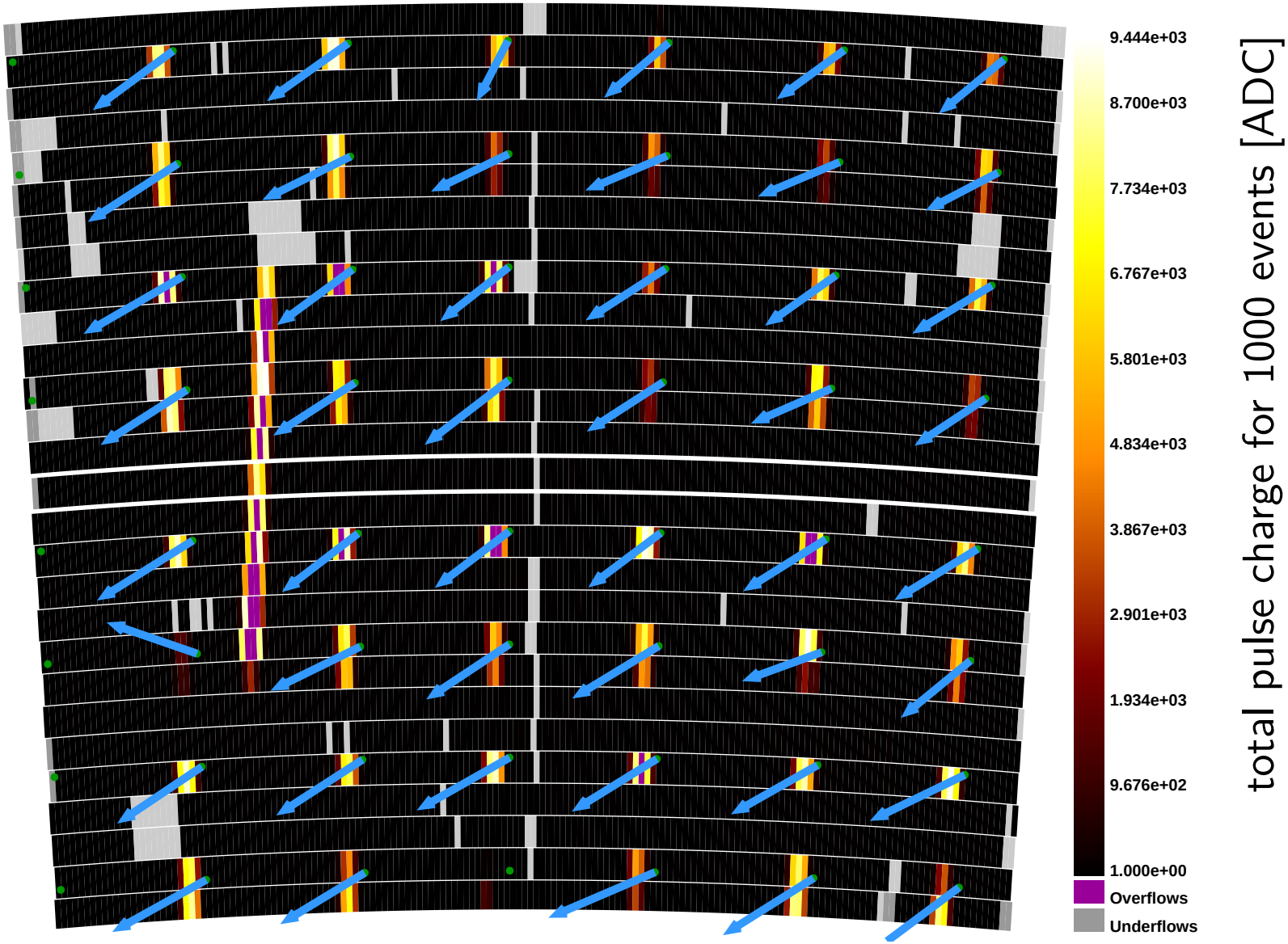
DESY GEM modules; $c_0 = r$ [mm], $c_1 = \varphi$ [rad]





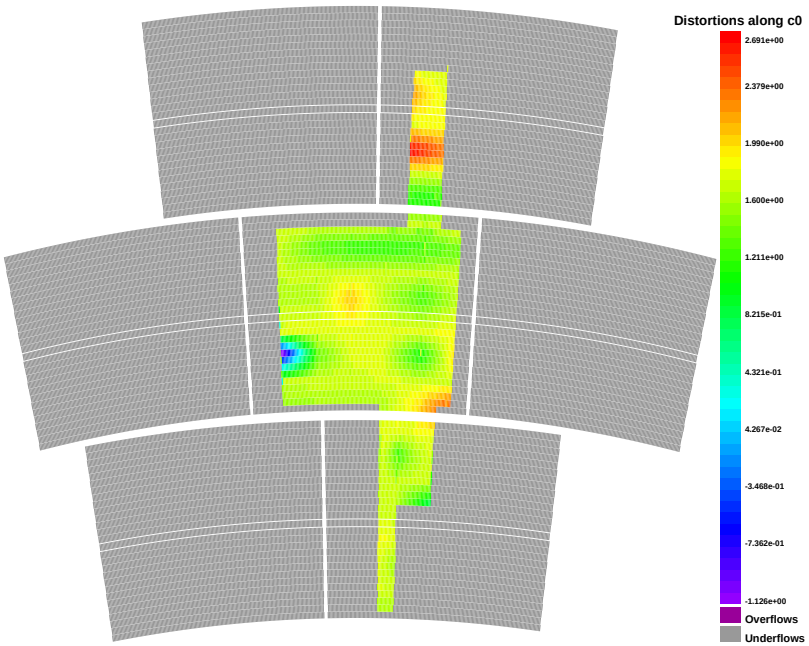
Central DESY GEM module

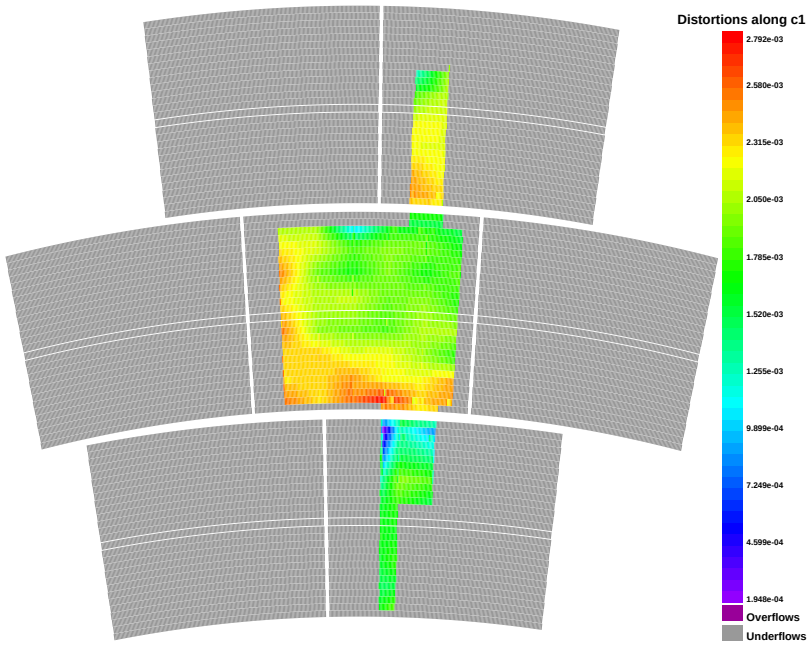
$B = 1\,\mathrm{T}$, $E_{\mathrm{drift}} = 240\,\mathrm{V/cm}$, Shift scaled by a factor 5



Distortions map for $B = 1\,\mathrm{T}, E_{\mathrm{drift}} = 240\,\mathrm{V/cm}$

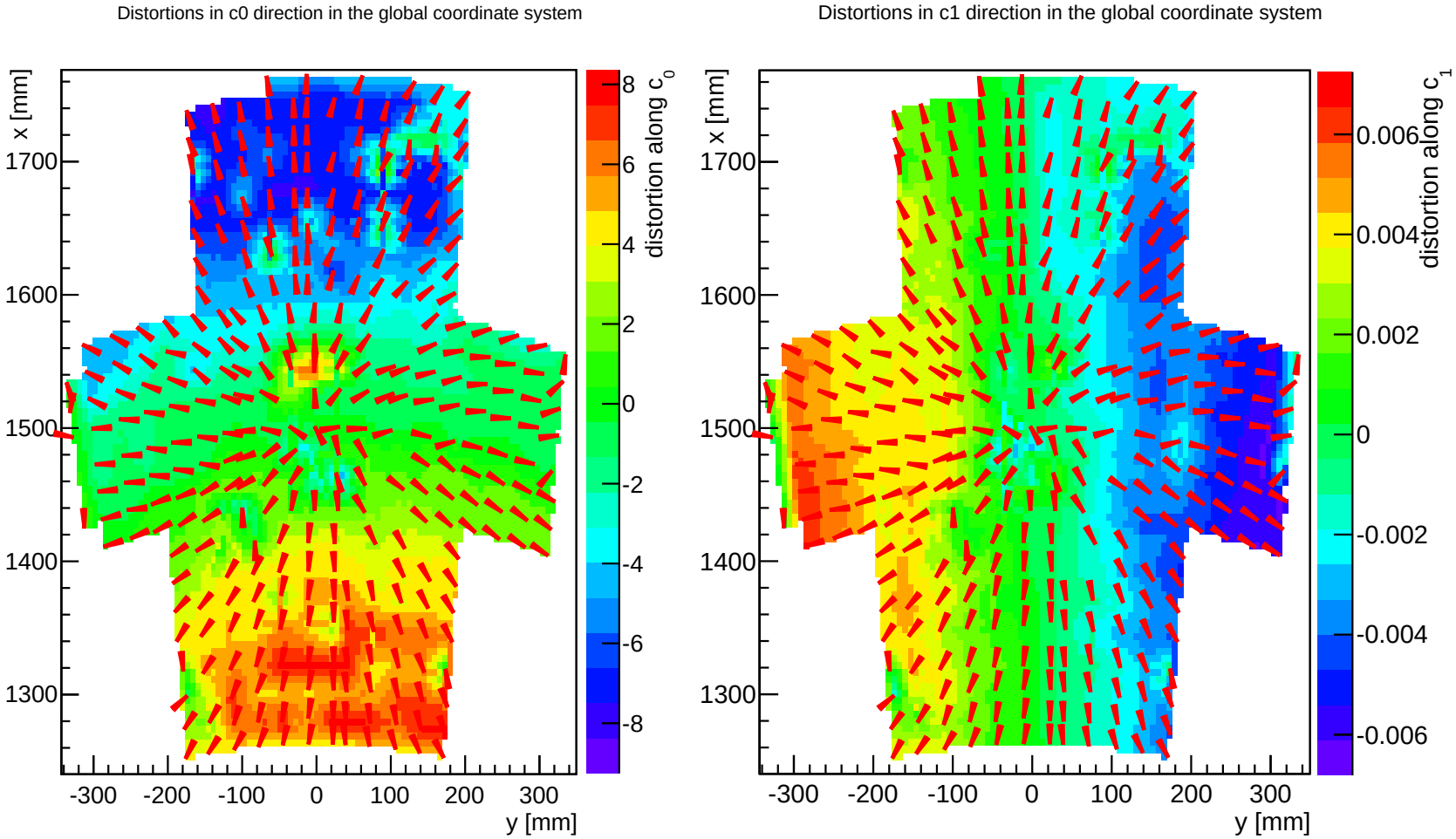
DESY GEM modules; $c_0 = r$ [mm], $c_1 = \varphi$ [rad]





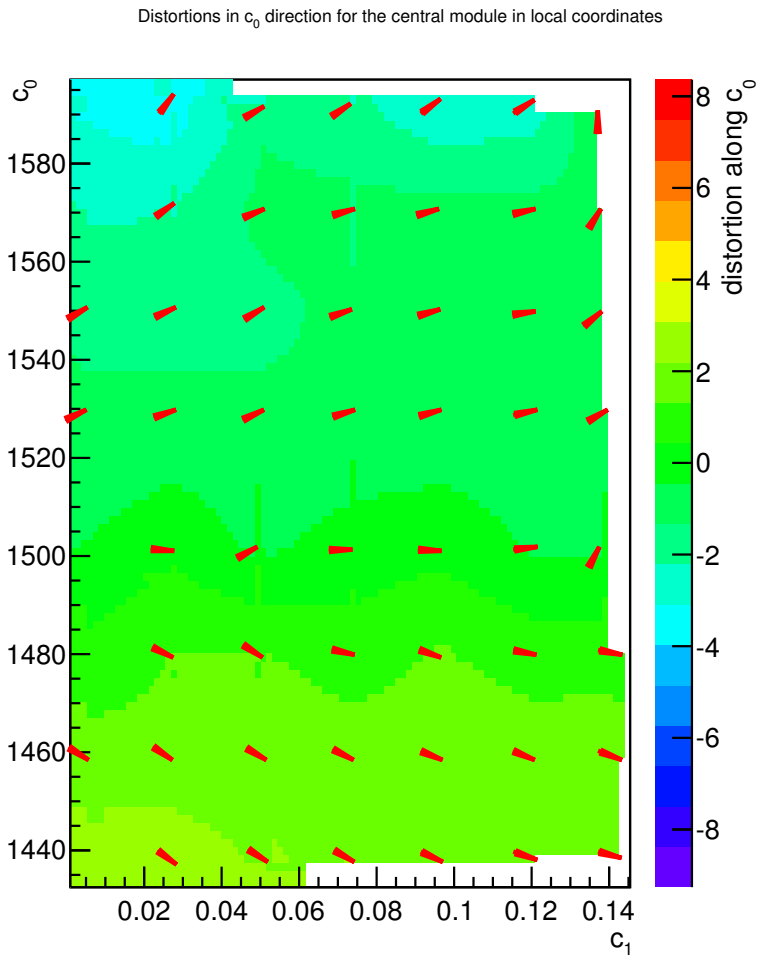
Distortions map for $B = 1\,\mathrm{T}$, $E_{\mathrm{drift}} = 240\,\mathrm{V/cm}$

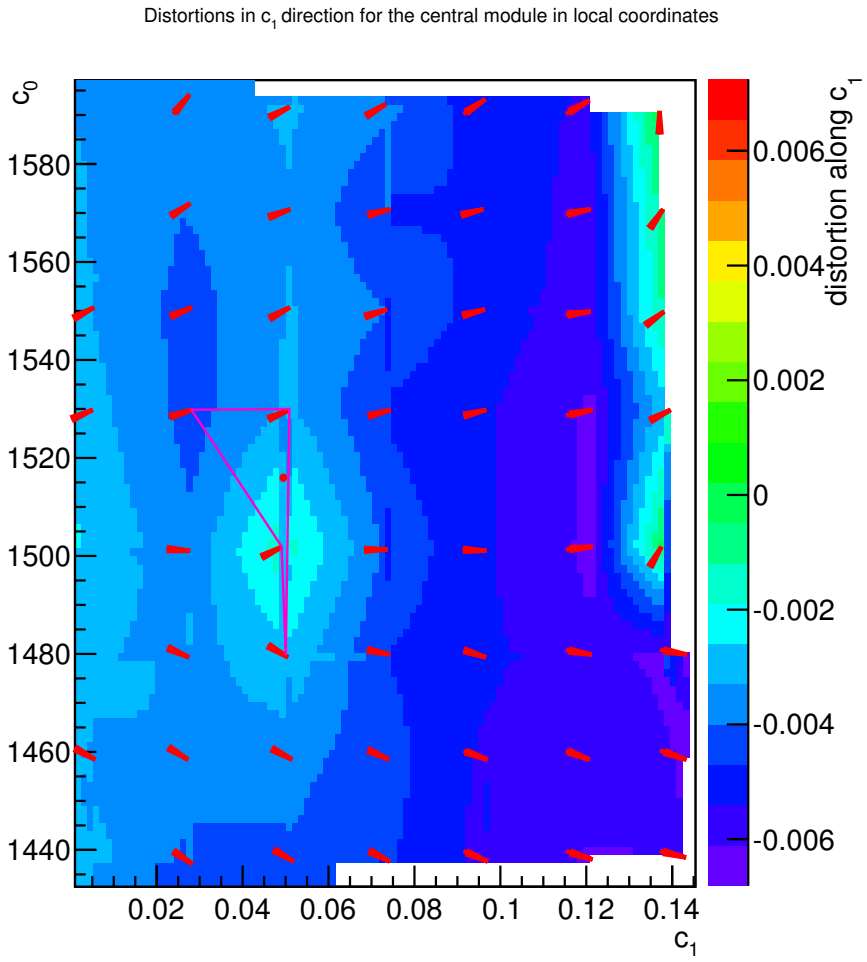
TPC is 15 cm outside the magnet center



Distortions map for $B = 1\,\mathrm{T}$, $E_{\mathrm{drift}} = 240\,\mathrm{V/cm}$

TPC is 15 cm outside the magnet center, module 2





Summary

- Reconstruction of the clusters is working
- Calculation of the distortions is working

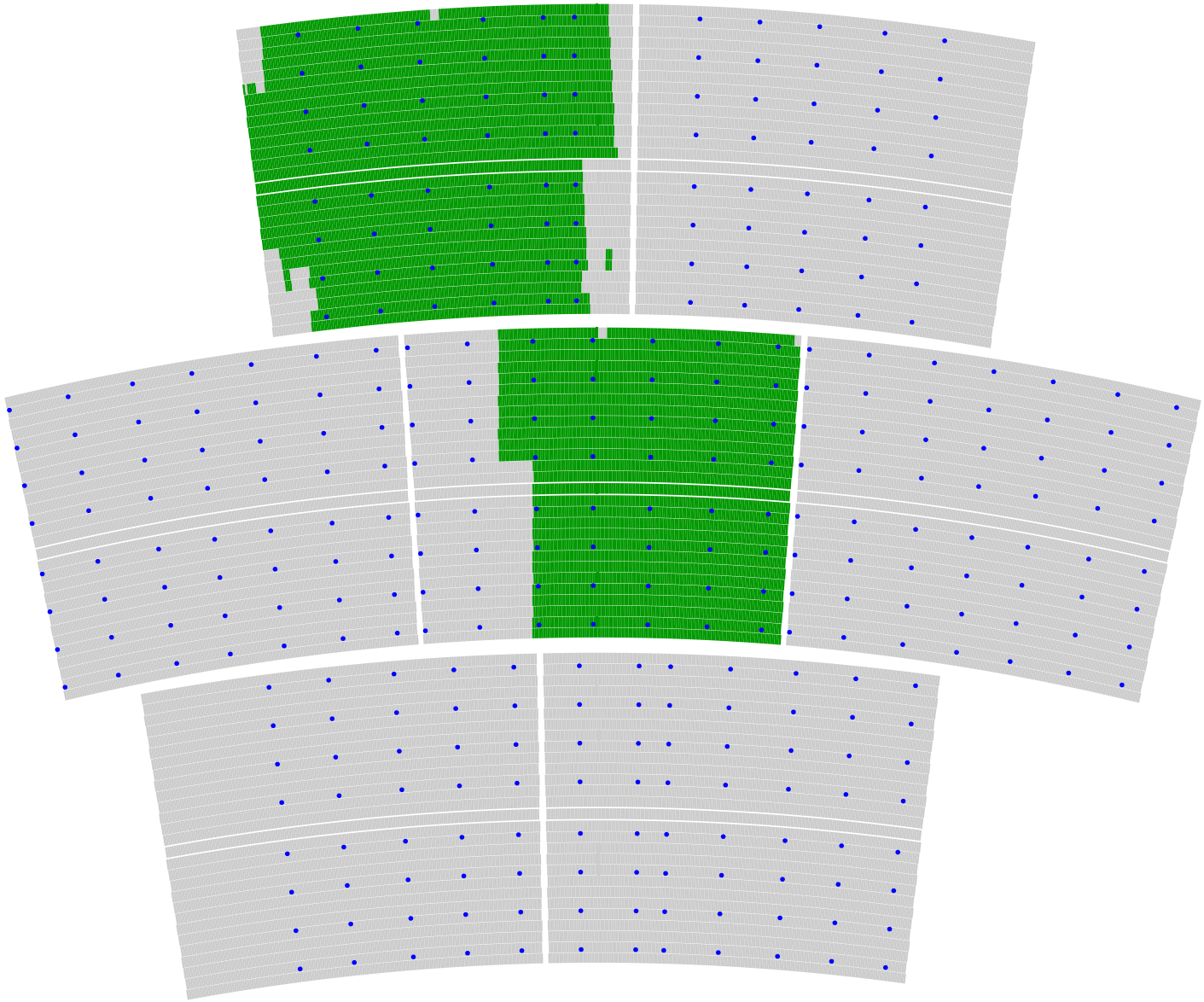
$\Rightarrow$ Distortions map is ready to be used

Outlook

- Systematic comparison of distortions between MicroMegas and GEM data as well as comparison with simulation
- So far:
  - There is a systematic shift of the reconstructed clusters in both data types for $B = 0\,\mathrm{T}$ ans $B = 1\,\mathrm{T}$
  - This can be explained with a tilt of the TPC with respect to the magnet axis
  - This was already measured by Volker and Ole

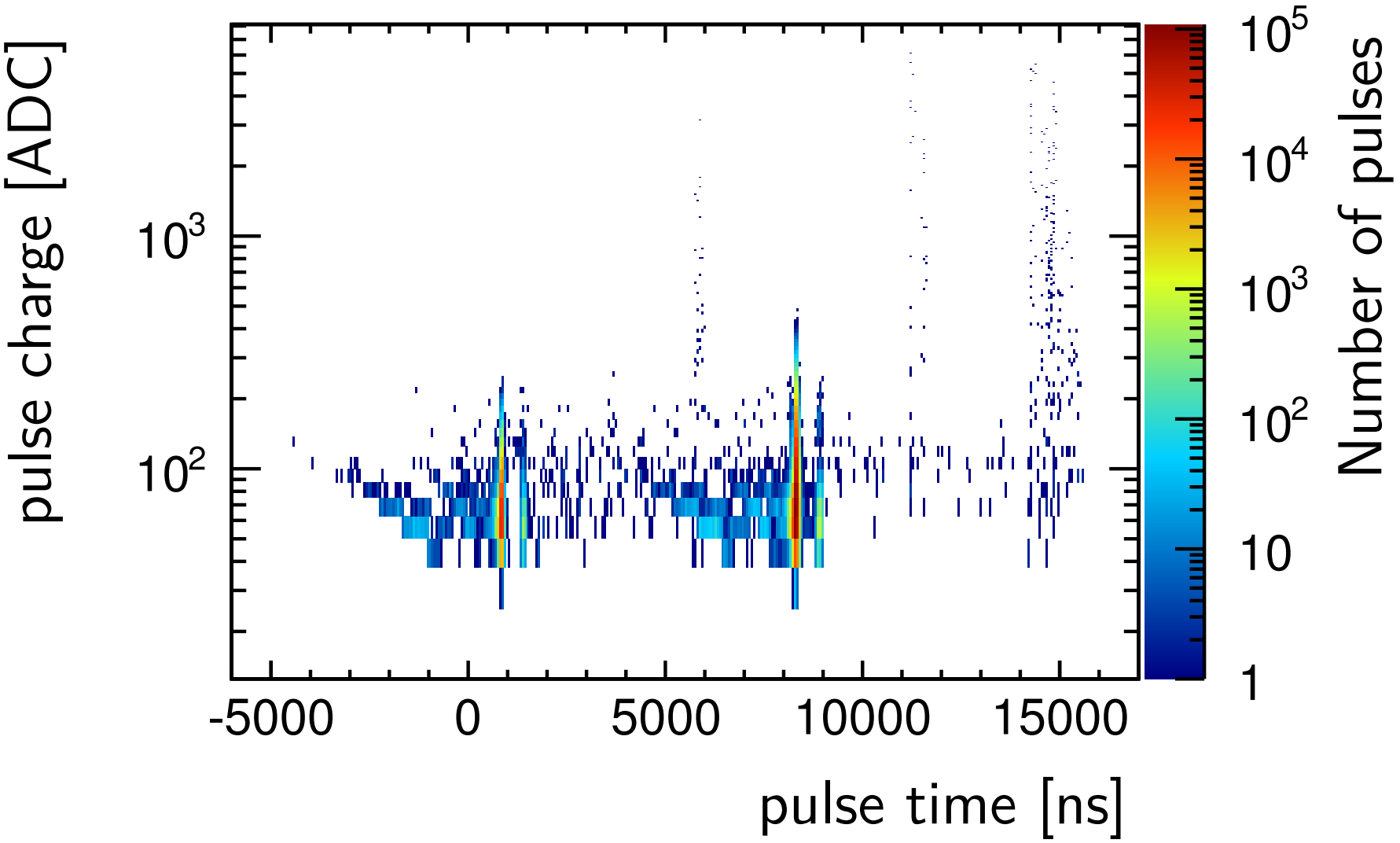
Backup

DESY grid-GEM channel mapping setup 2



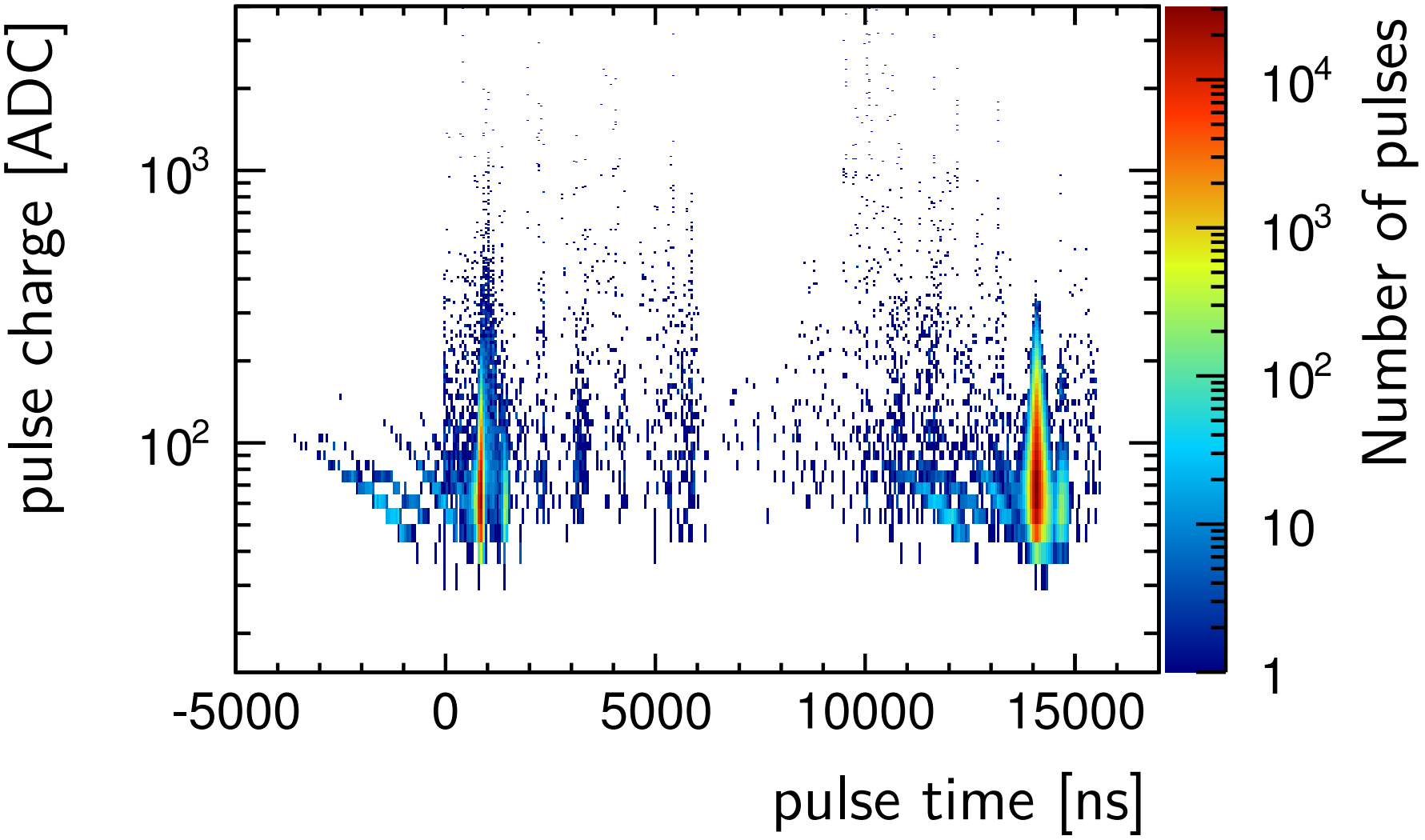
Reconstructed pulse charge vs. time

DESY Modul, $B = 0\,\mathrm{T}$, $E_{\mathrm{drift}} = 240\,\mathrm{V/cm}$



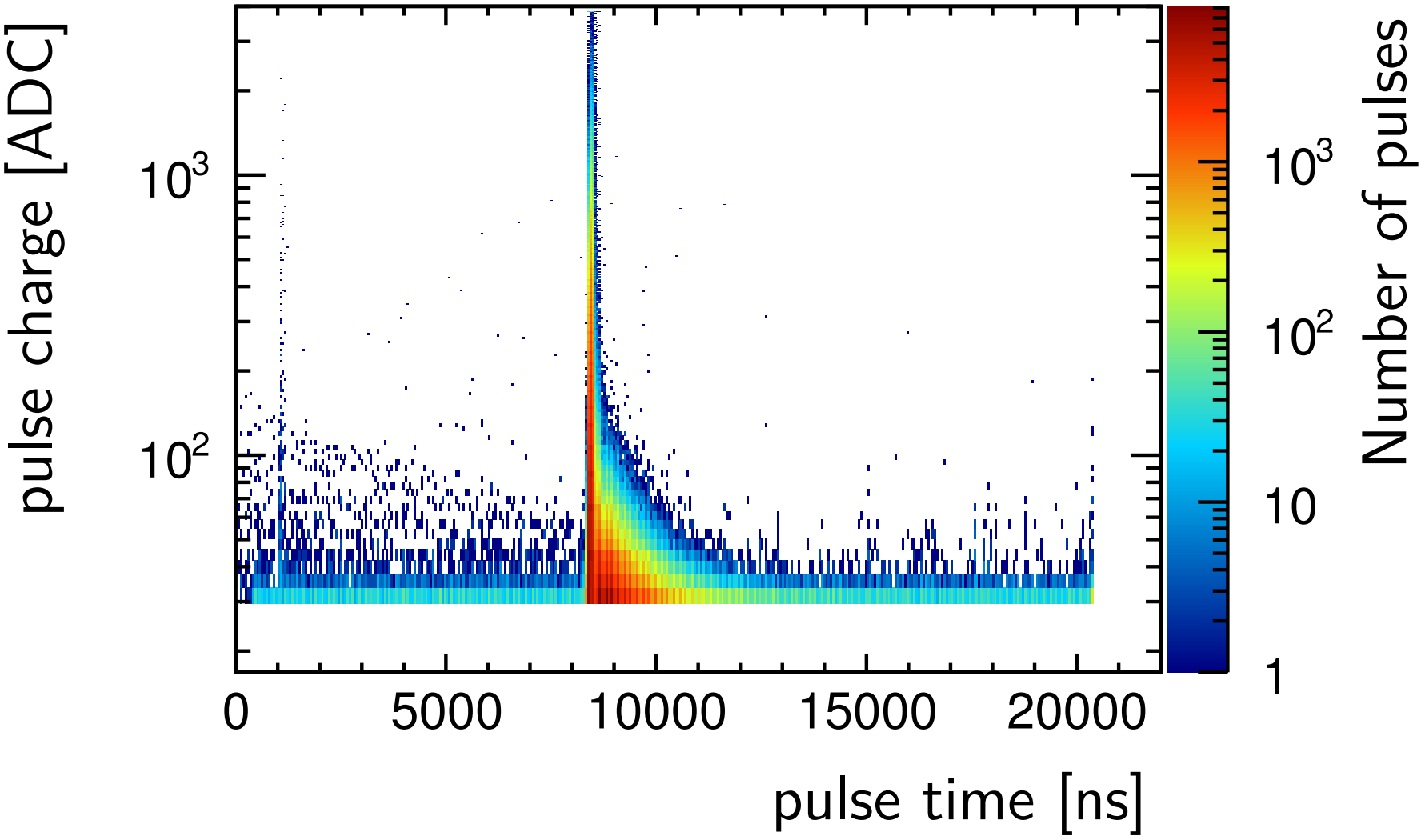
Reconstructed pulse charge vs. time

DESY Modul, $B = 0\,\mathrm{T}$, $E_{\mathrm{drift}} = 100\,\mathrm{V/cm}$



Reconstructed pulse charge vs. time

MicroMegas Modul, $B = 0\,\mathrm{T}$, $E_{\mathrm{drift}} = 240\,\mathrm{V/cm}$



Reconstructed pulse charge vs. time

MicroMegas Modul, $B = 0\,\mathrm{T}$, $E_{\mathrm{drift}} = 100\,\mathrm{V/cm}$