

# Small-drift TPC with an open field-cage

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RD51 Mini-Week (Dec2018)

# Experimental Environment

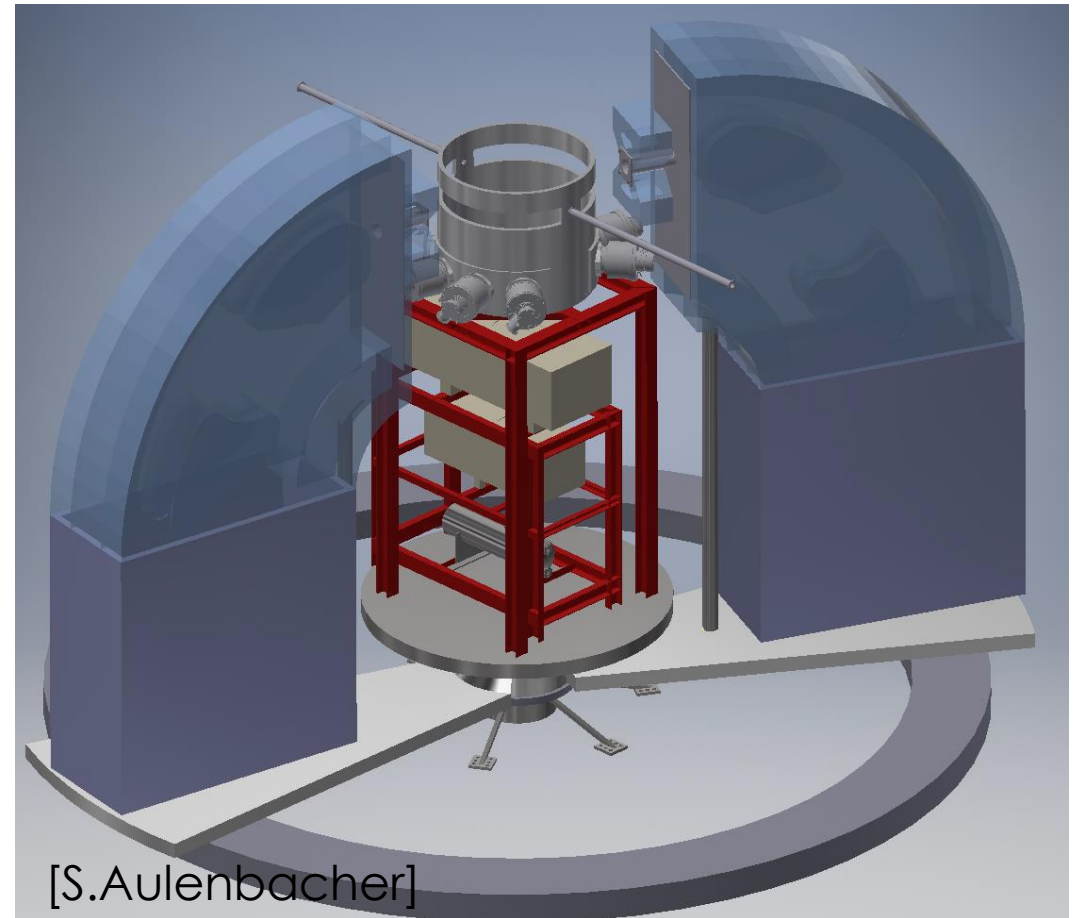


## MESA

- Mainz Energy-recovering Superconducting Accelerator
- Electron accelerator
- 2 different modes
- 2 main experiments
- Under construction

## MAGIX

- MESA Gas-Internal Target eXperiment
- Energy up to 105 MeV
- Current up to 1 mA
- Jet-Target
- 2 magnetic spectrometers
- $\frac{\Delta p}{p} \leq 10^{-4}$
- $\Delta\theta \leq 0.05^\circ$



[S.Aulenbacher]

# Setup still in flux

## Versatile physics program

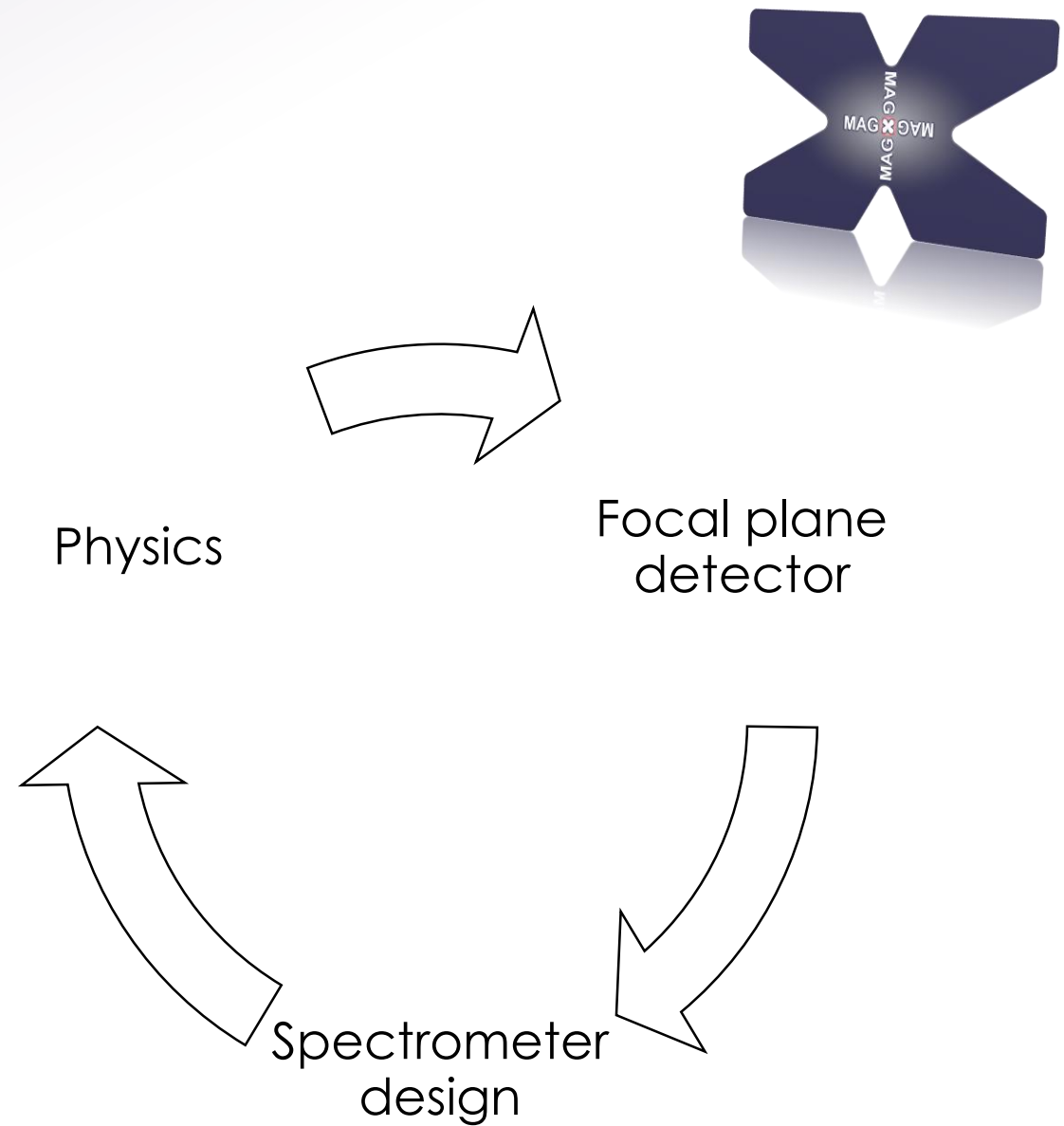
- form-factor measurements
- dark photon search
- astrophysical cross-section

## Good R&D environment

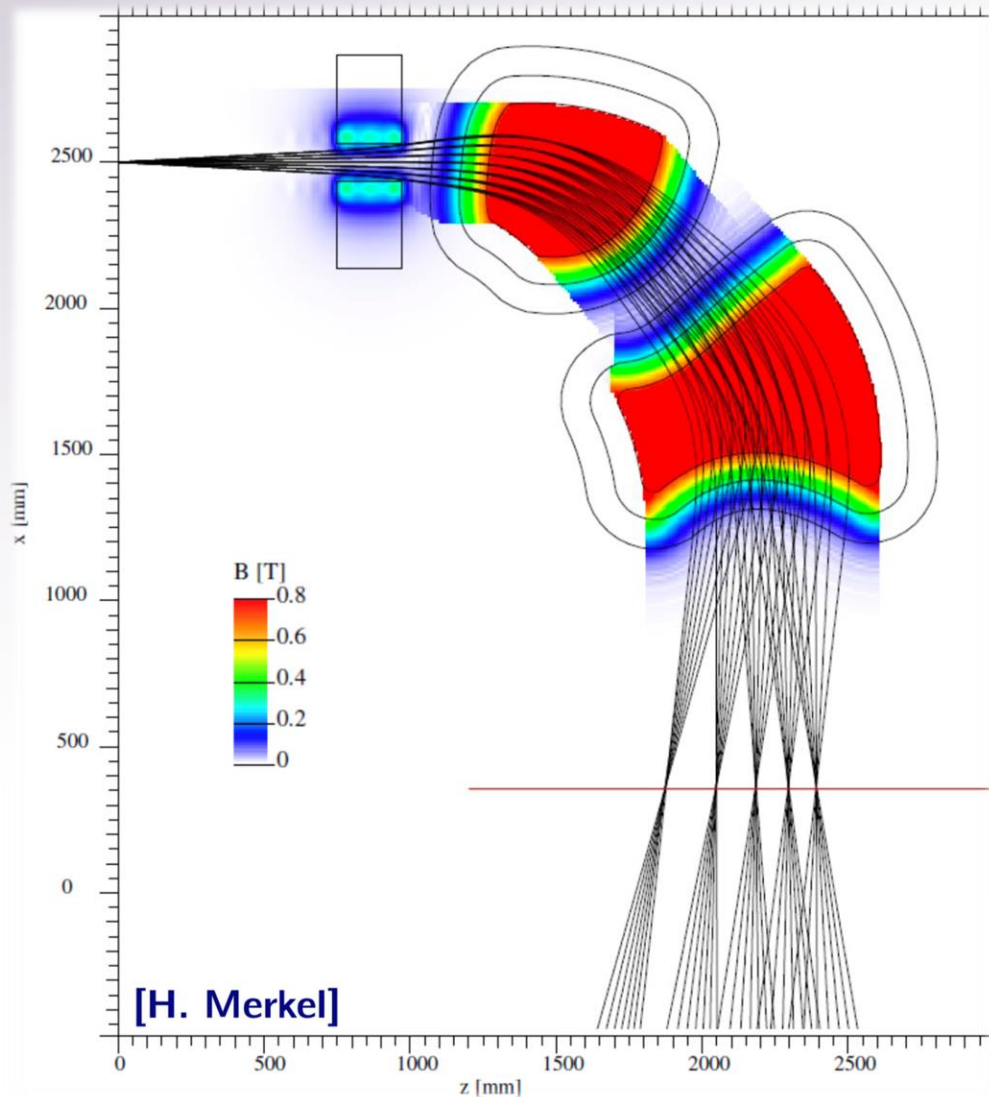
- dedicated gas-detector-lab
- beamtimes @ MAMI

## But

- time starts to press
- we need a feasible design



# Spectrometer design



## Magnetic Spectrometers

- Map momentum and scattering angle to focal plane
- We need detector with good spatial and angular resolution
- Possible to exchange acceptance with resolution

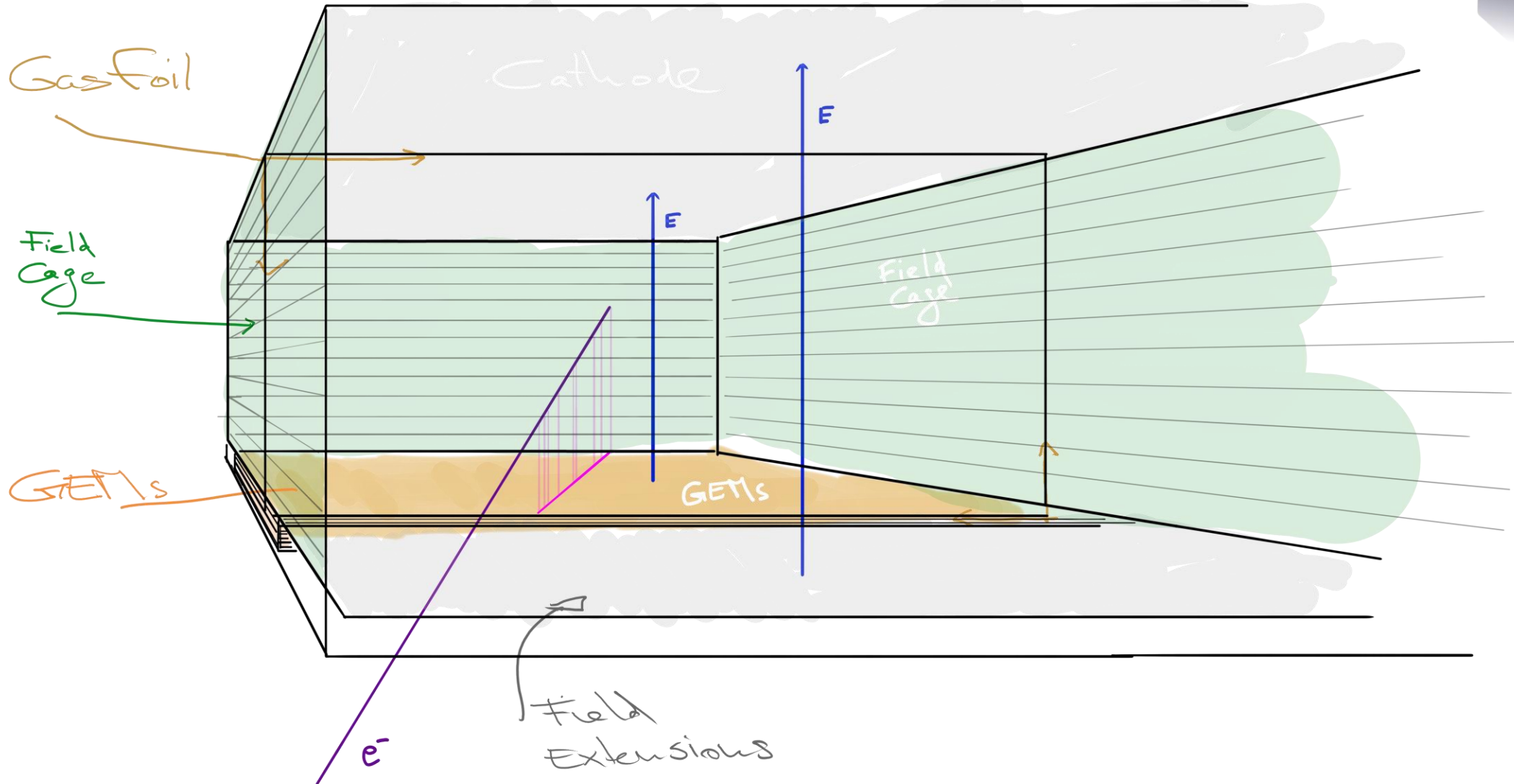
## Low energy

- Mostly electrons below 105 MeV

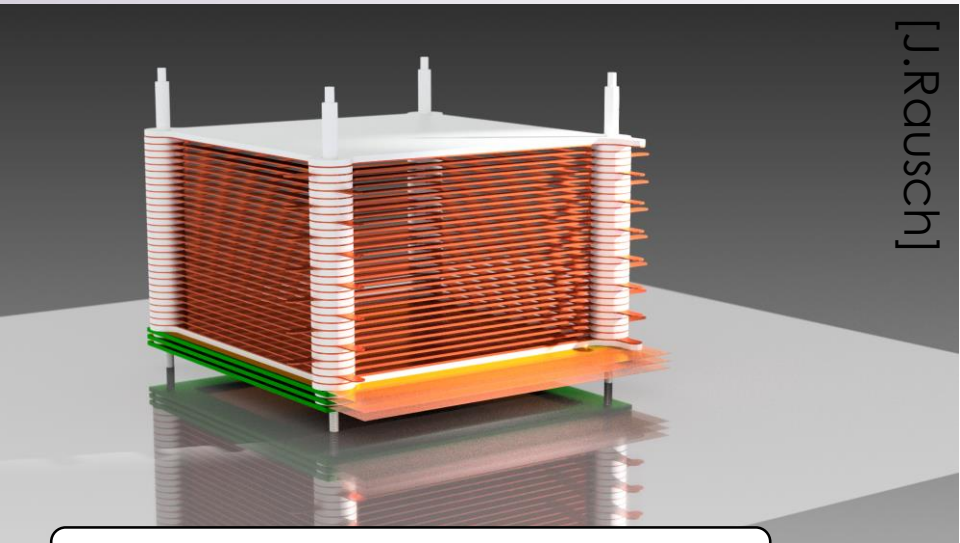
## Focal plane

- 1m x 0.15 m
- Low strain fields below magnet
- A lot of free space before focal plane

# Open the field-cage on entrance face



# Simulation of drift-field (closed)

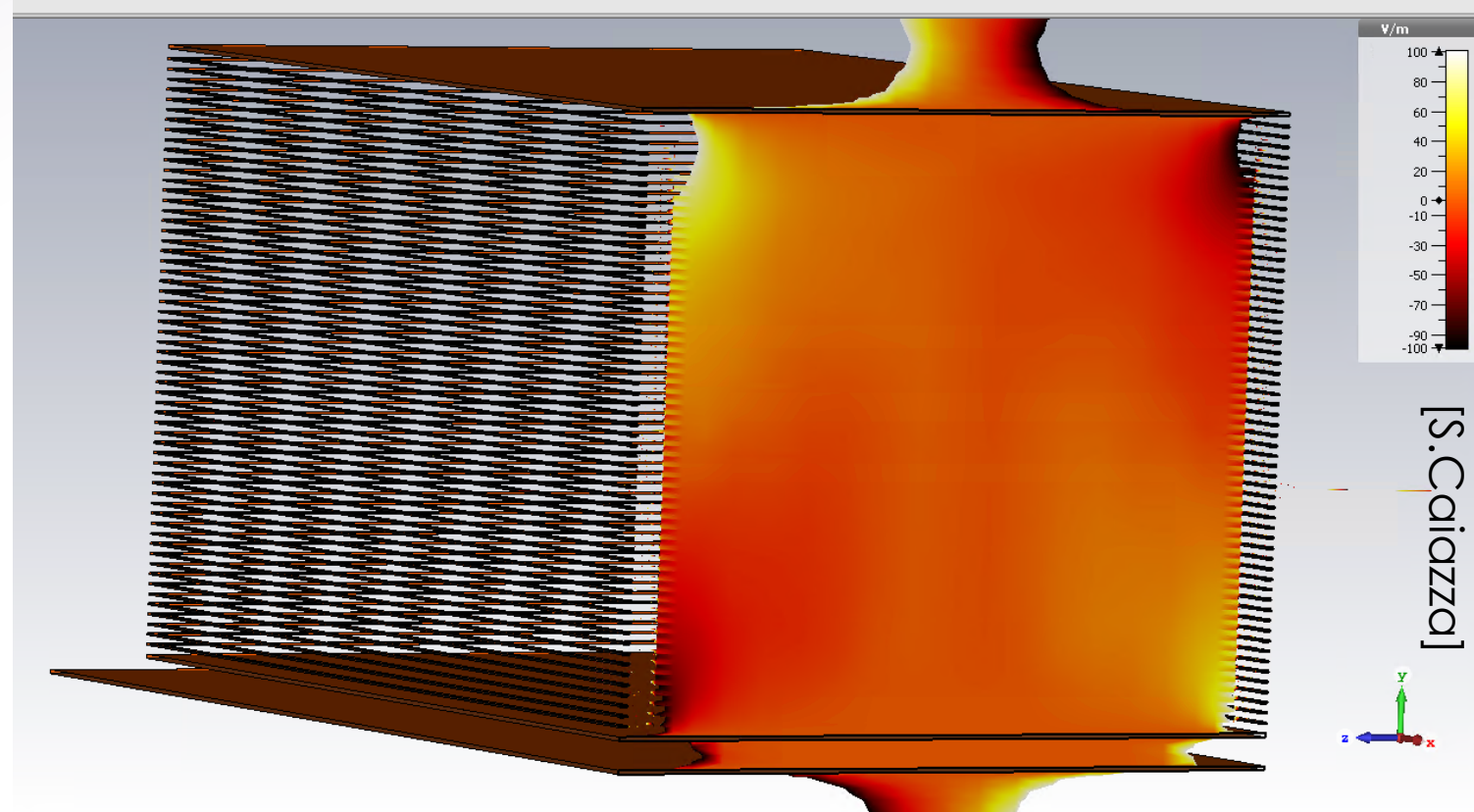


field cage

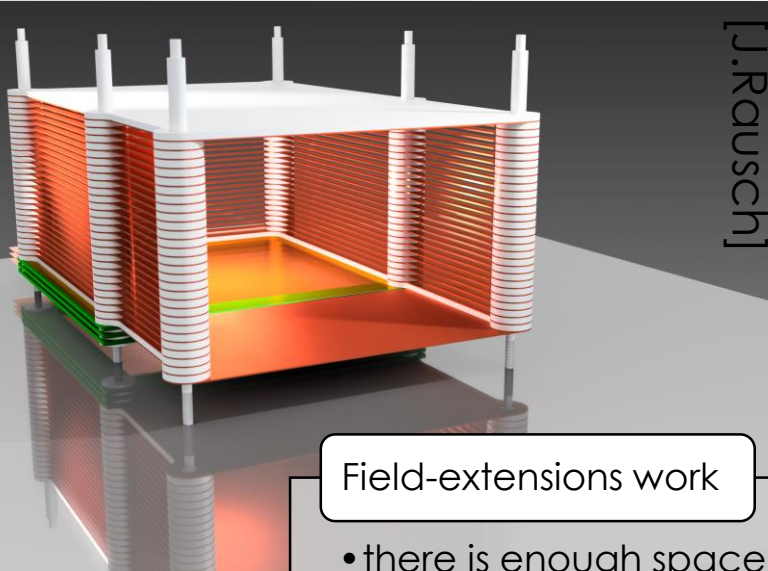
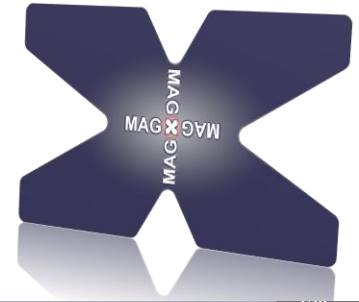
- 2 mm wide(x-z), 0.5 mm thick(y) rings, 8 mm gap to the sensitive volume
- 0.5 mm wide(y) strips 10 mm gap to the sensitive volume

Simulation check with closed cage

- field looks as expected
- seems to work



# Simulation of drift-field (open)

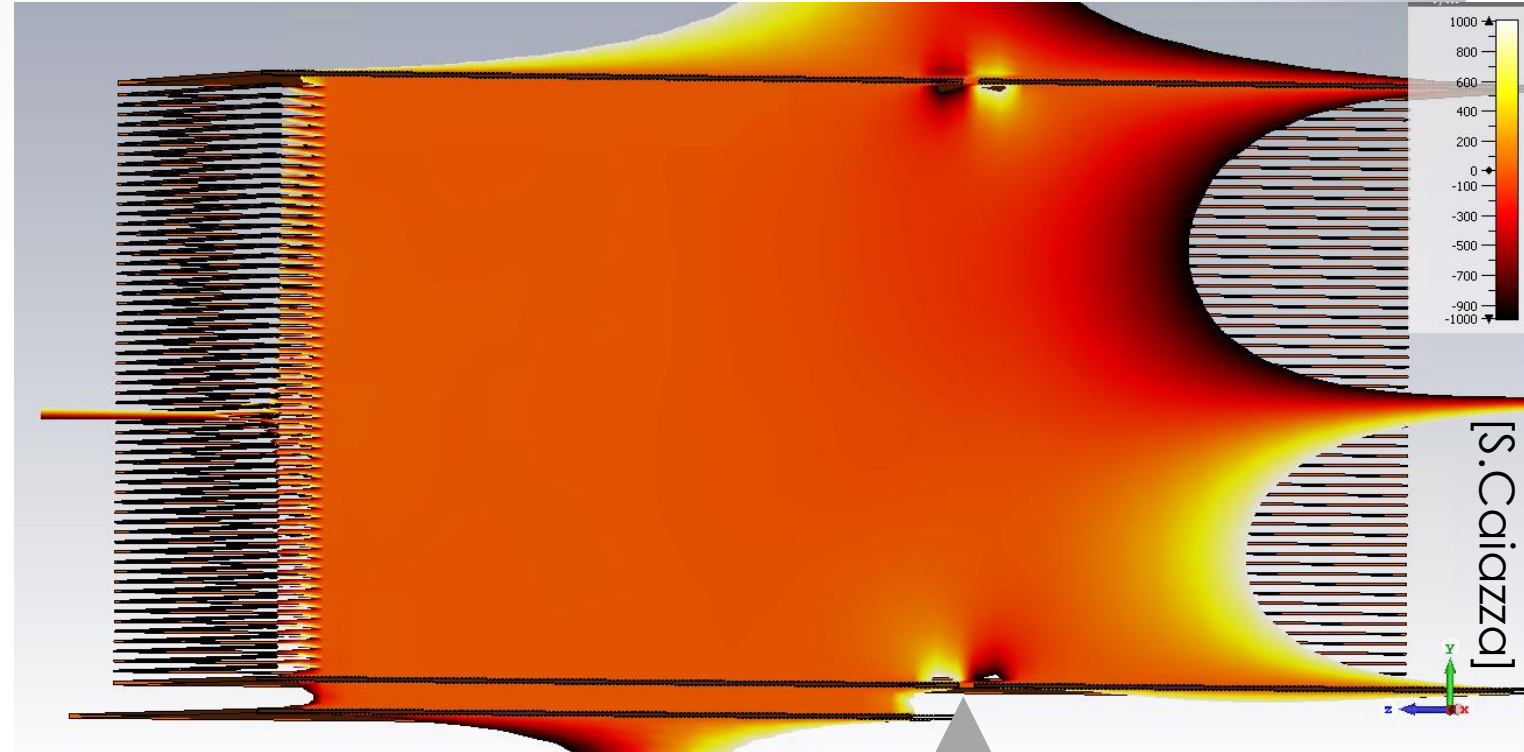


Field-extensions work

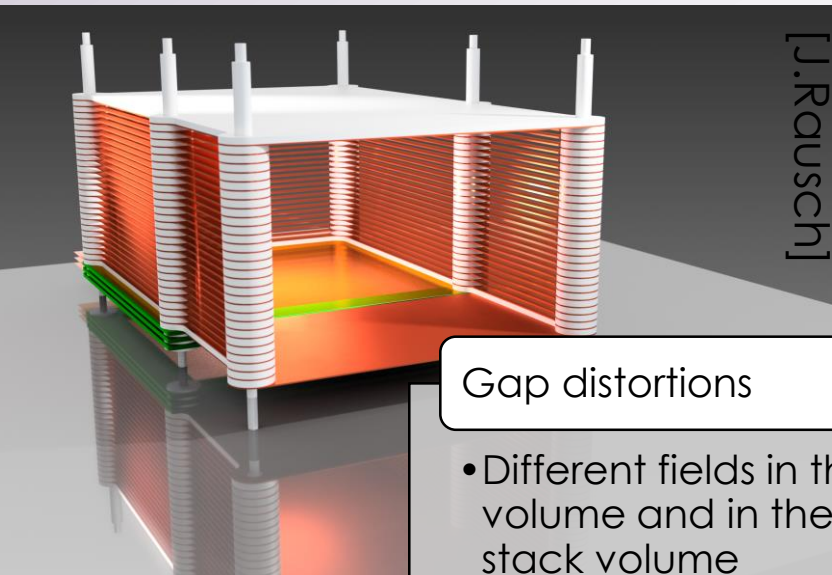
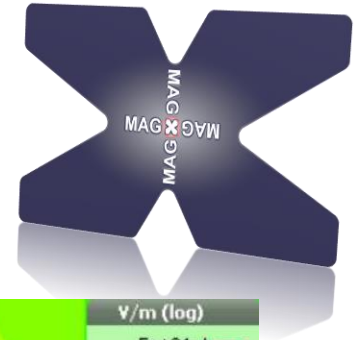
- there is enough space to homogenize the field
- We need 150 mm

Crucial edge

- between GEM-Stack and field-extension
- remember: vacuum-foil sits here

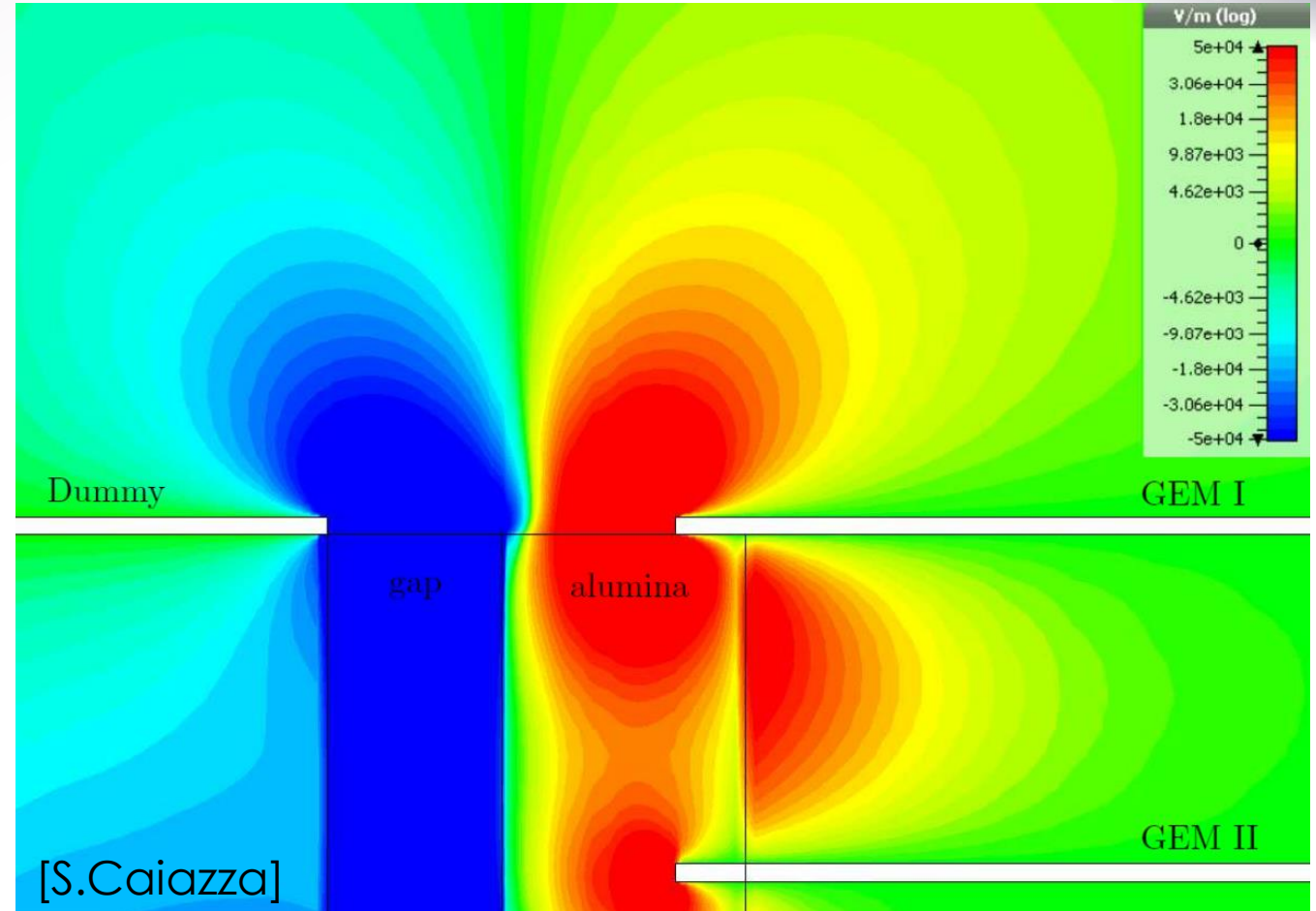


# Simulation of drift-field (open)



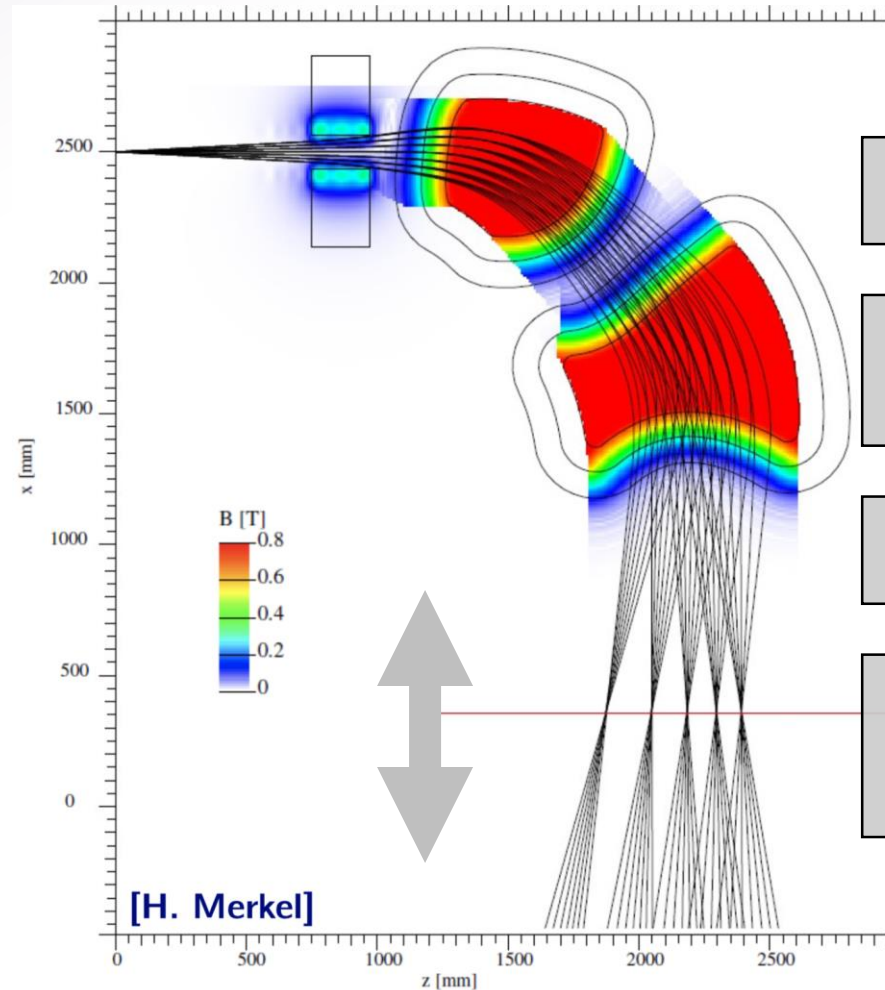
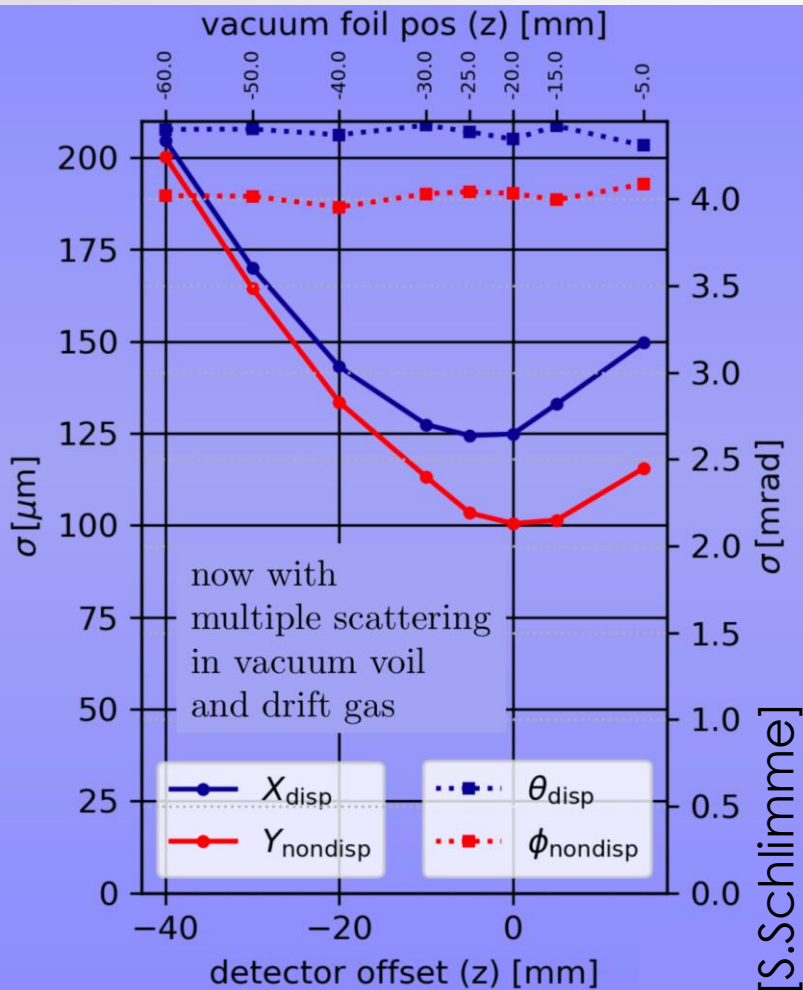
## Gap distortions

- Different fields in the drift volume and in the GEM stack volume
- Distortions in the gap between the window and the GEM
- We need additional field shaping in the gap to limit this effect
- The first row is the one most interested by this effect so we should be very careful about this





# Detector placement



Where to place the detector?

- to get best track resolution

without foil

- focal plane in middle
- as expected

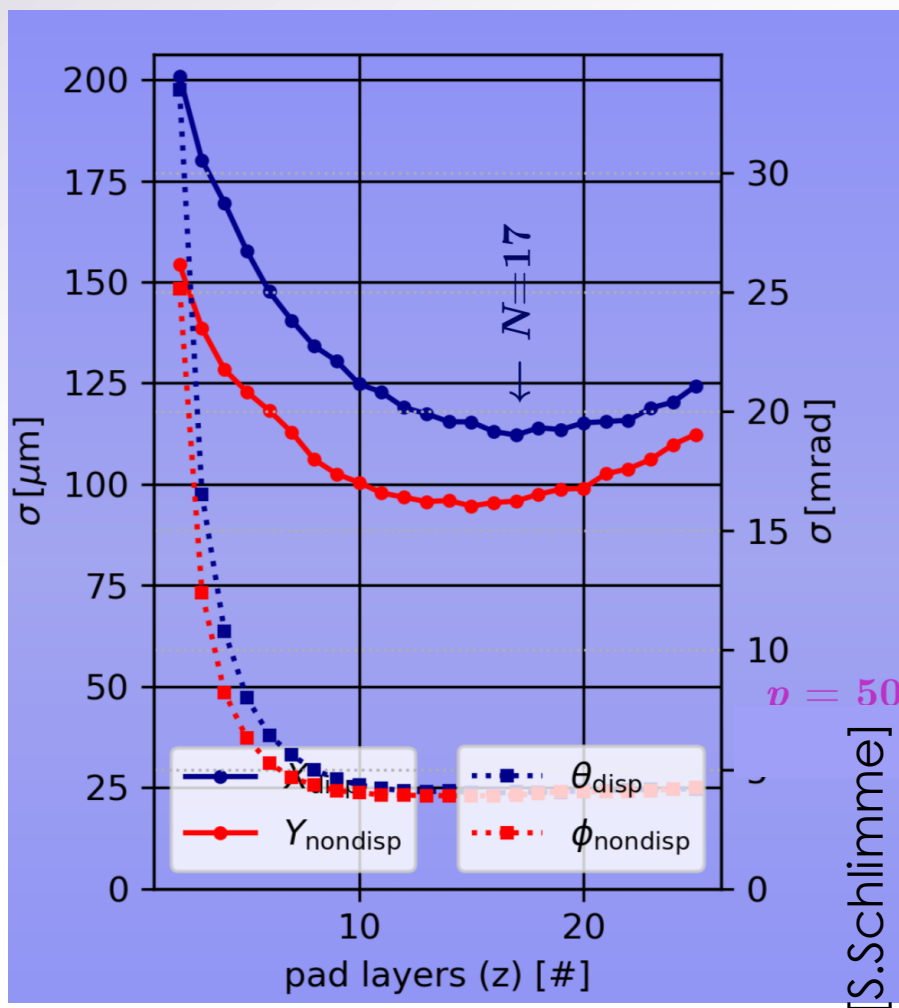
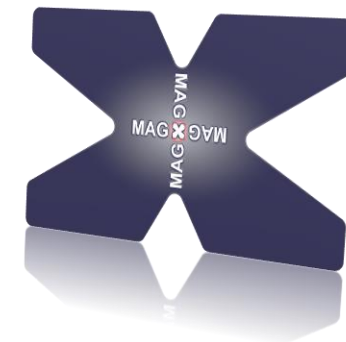
with vacuum foil

- first pad rows

problems to be solved

- bending of the foil
- minimize gap between GEMs and field extension

# Detector length / pad rows



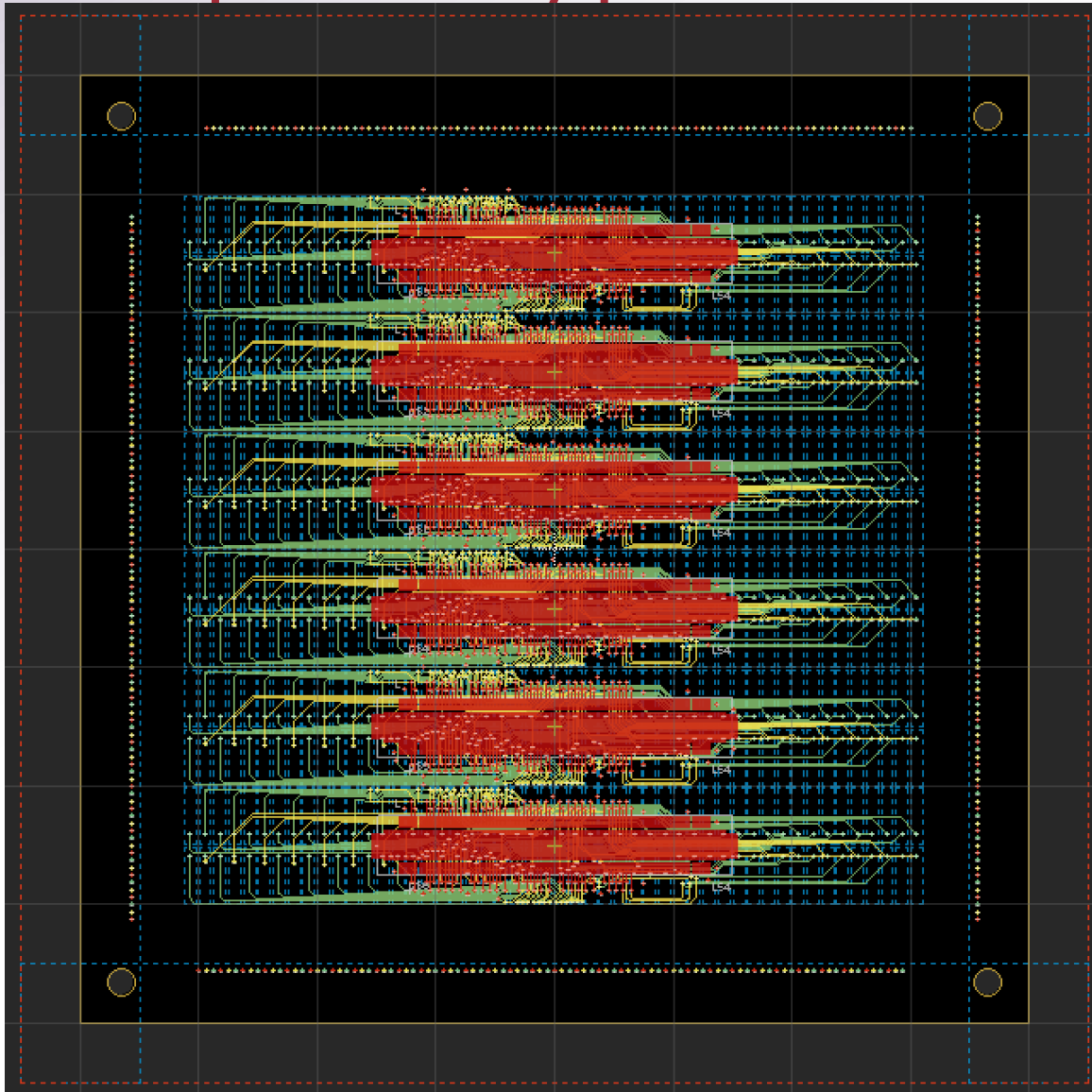
Pad rows

- 17 rows seem to be optimum
- detector will fit in!

more dedicated simulation needed

- with different pad-sizes
- with gas-properties included

# 1st prototype TPC



## Pad size

- 2 mm x 8 mm

## new HRS connectors

- enables usage of VMMs
- taken care of neighboring

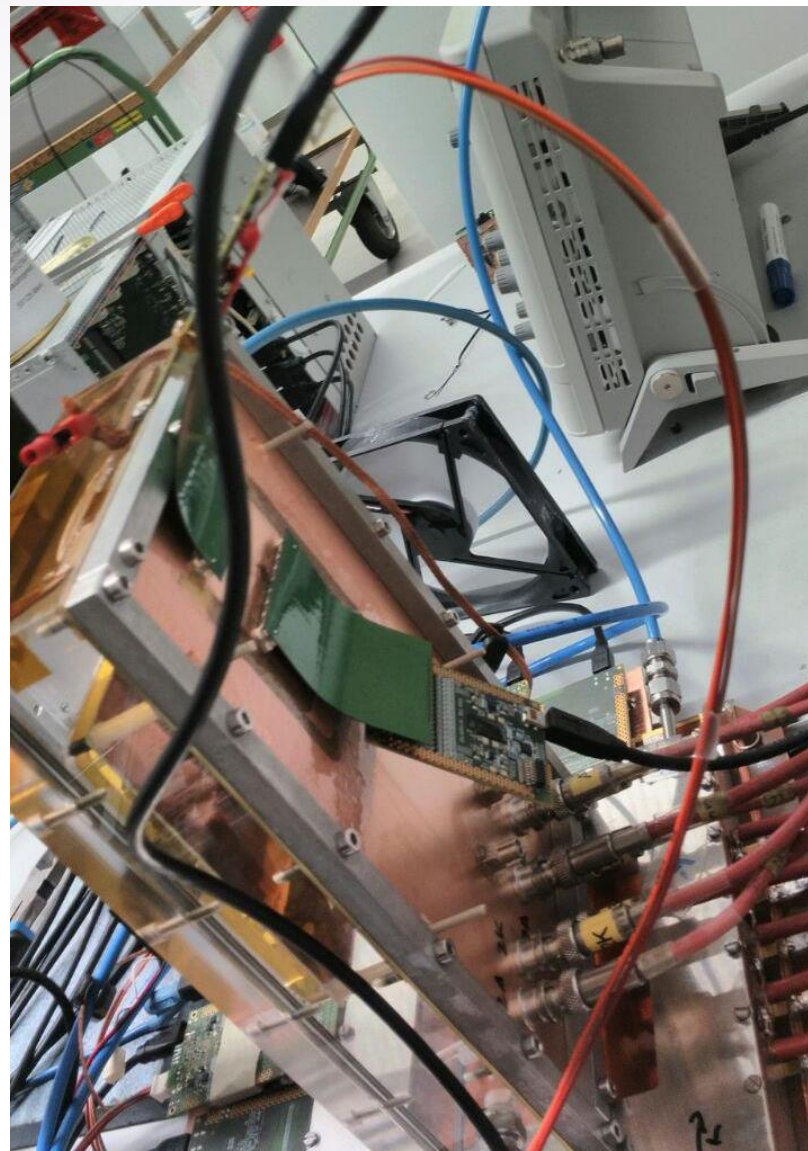
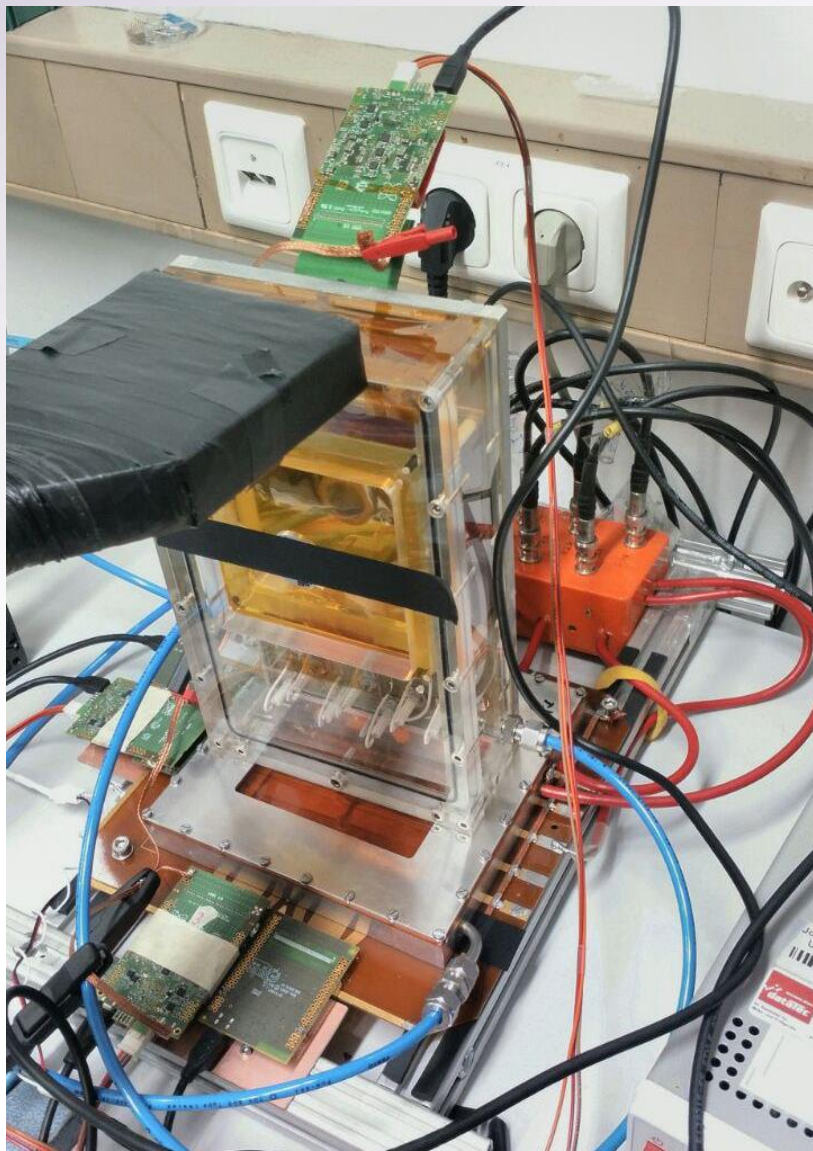
## PCB already produced

- detector will be assembled this week

## Housing

- possible to mount different field-cages

# TPC + VMM



Small drift: 5 cm

7 x 4 pads

- 2 mm x 8 mm
- in the middle of active area

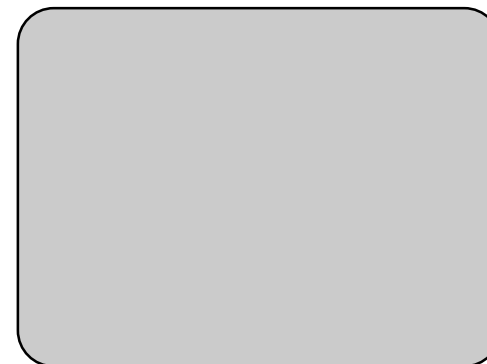
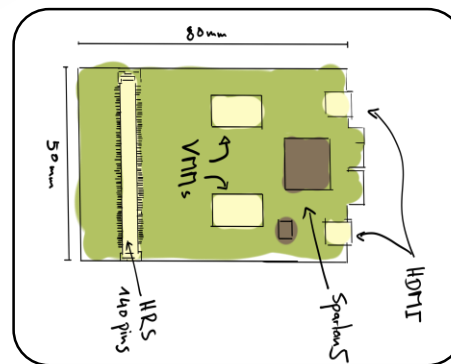
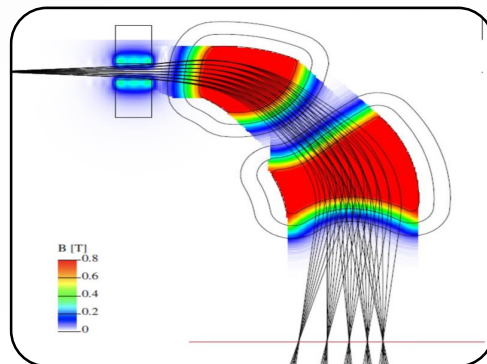
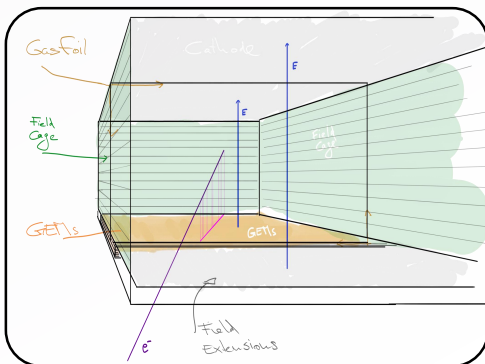
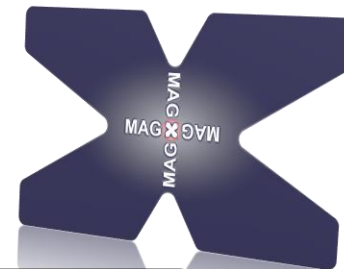
APV + VMM in parallel

- connected to same pads

Analysis in progress

- also beam-time with triple GEM
- see talk by Stefano 06/12/18 11:00

# Conclusion



## Field-cage

- Open solution seems achievable
- Simulation looks good
- Problem shifts to gap
- Solution needed

## Focal plane

- Focal plane at first pad rows
- More dedicated simulation needed

## Readout

- We would like to use VMM3
- Already took data
- Has to be analyzed

## Not touched

- Rate-capability
- Ion-backflow
- GEM-layout
- Anchor-GEM
- Final gas-mixture
- Calibration-system
- ...

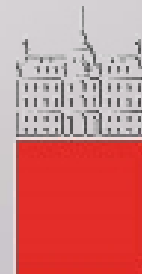


**THANK YOU FOR YOUR ATTENTION!**

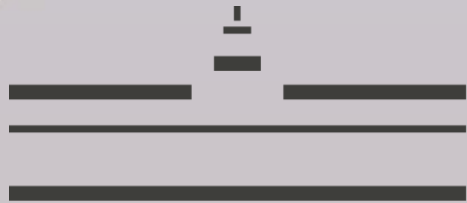
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