Development of thin GEM readout structures

Yasemin Schelhaas

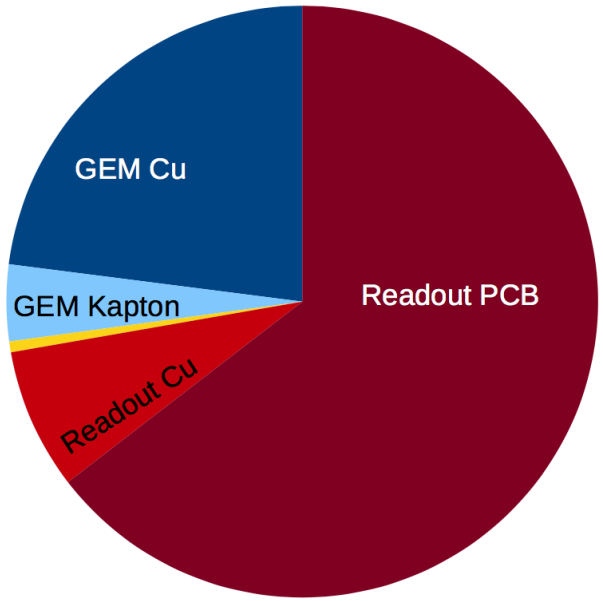
MAGIX Collaboration Meeting 2017-02-16

Topics

- Layouts
- Manufacturing plans
- Testing plans
- Open questions

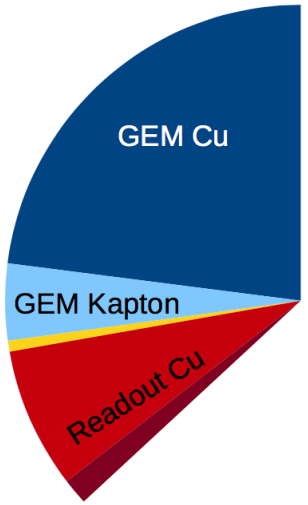
Motivation

- Aim: **Small radiation thickness**
- Make material thinner
- Material budget:



Default triple GEM detector
0.96% X_0

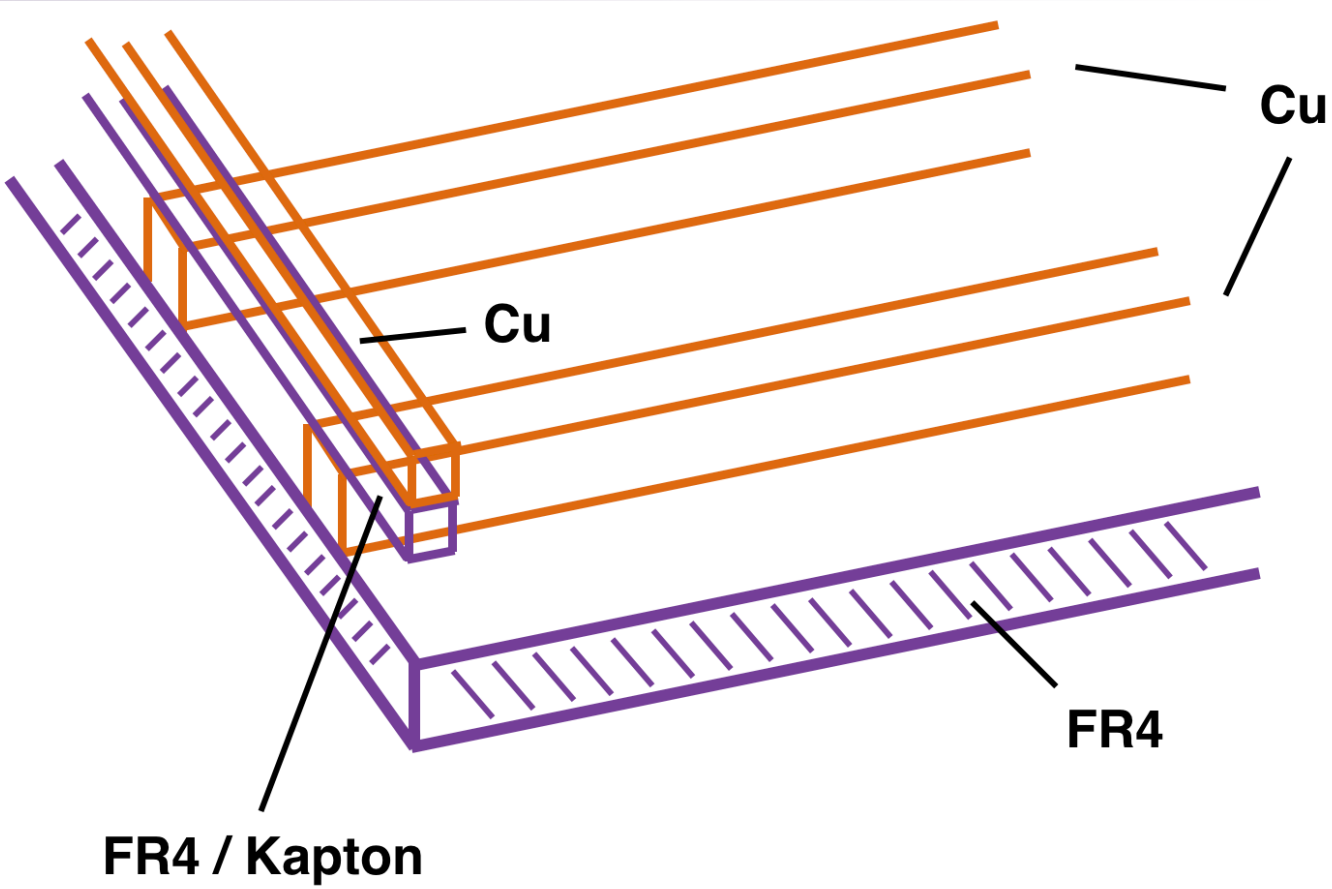
Foil
Readout
100 µm
Kapton



0.38% X_0

→ Go to **foil layout**

Traditional Layout



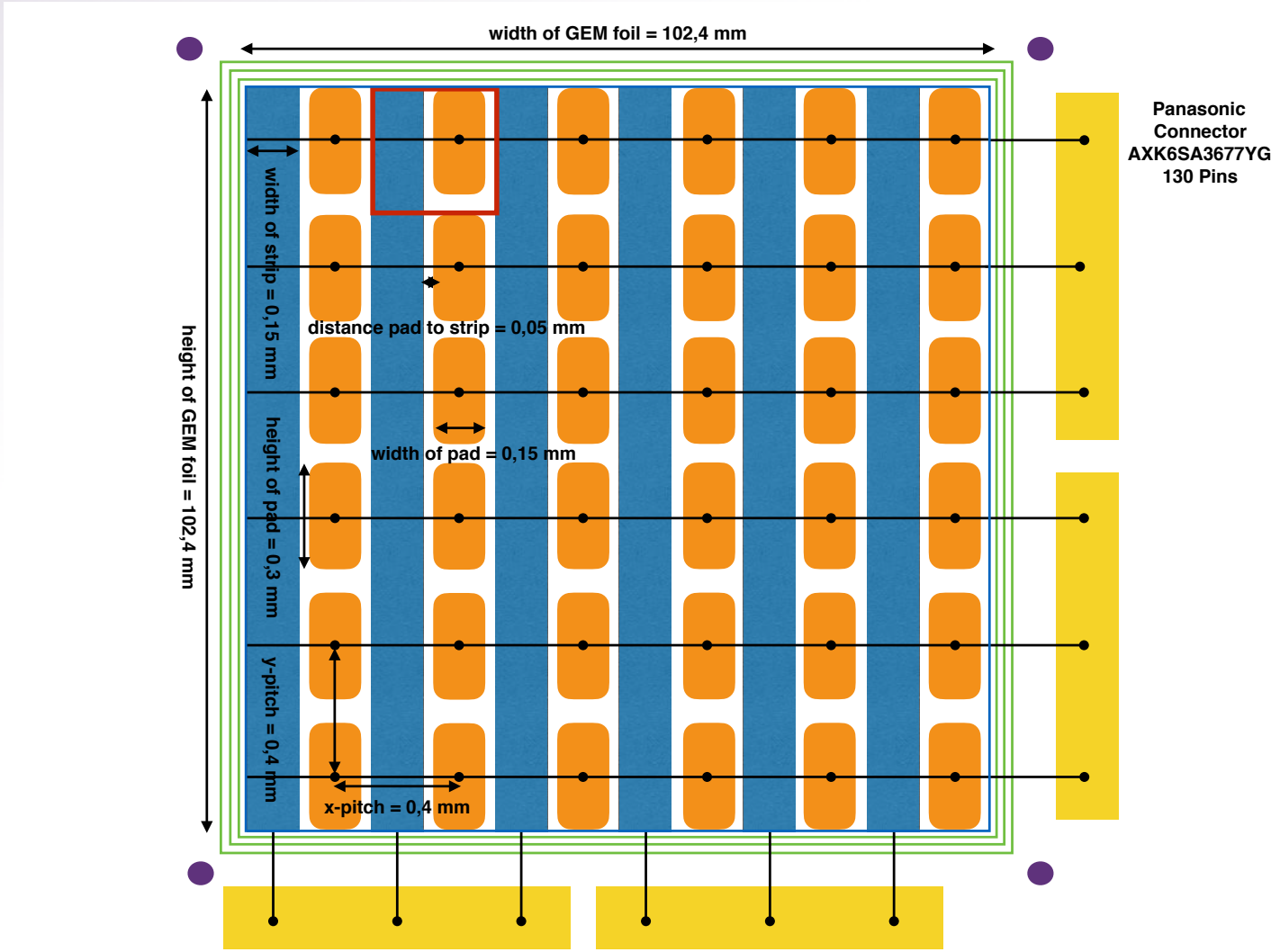
Problems:

- Big and thick support structure
- Crossed Cu strips

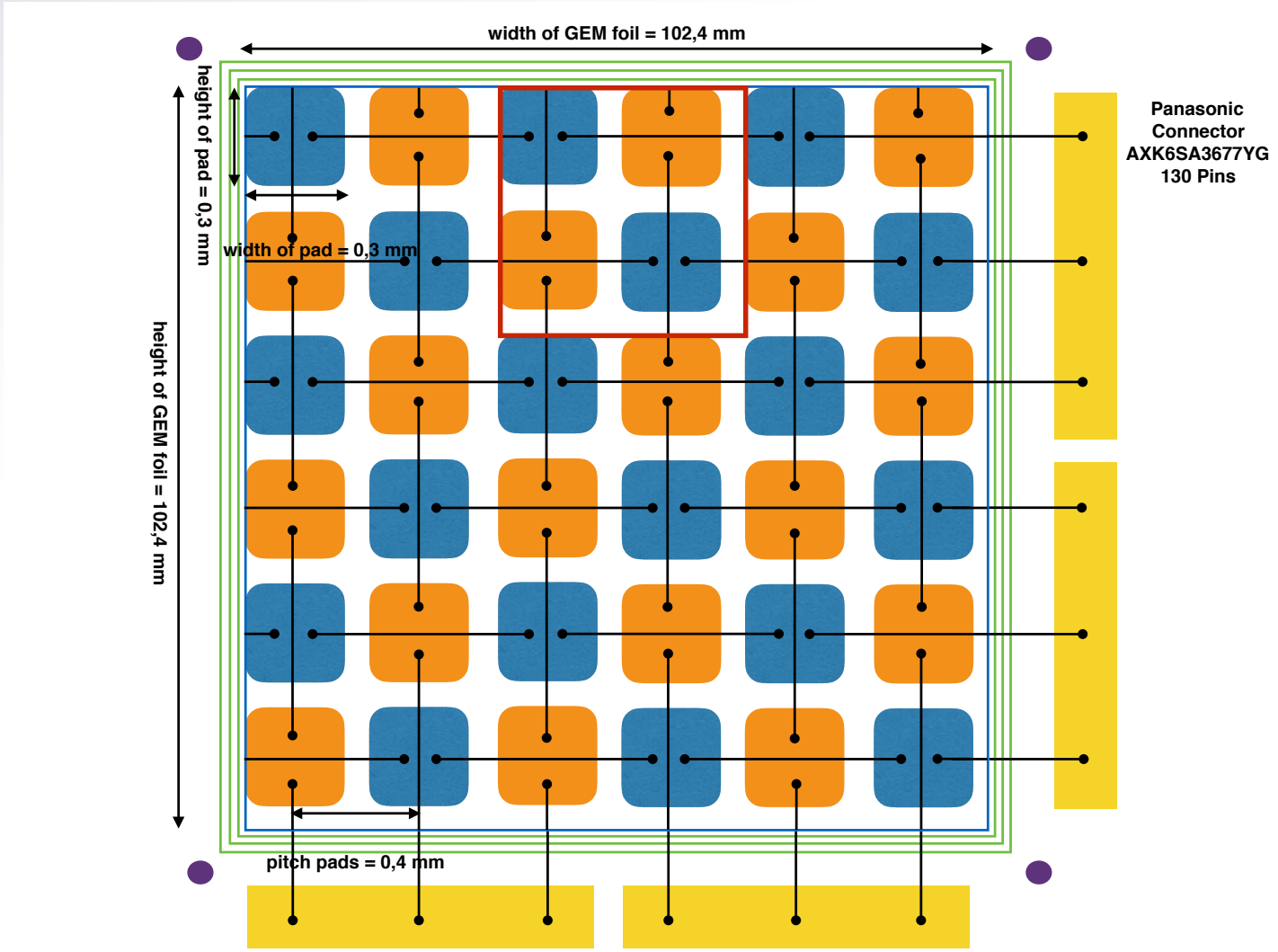
→ Twice as much material as needed

→ Go to **one layer**

Strips & Pads design



Strads design



Layouts

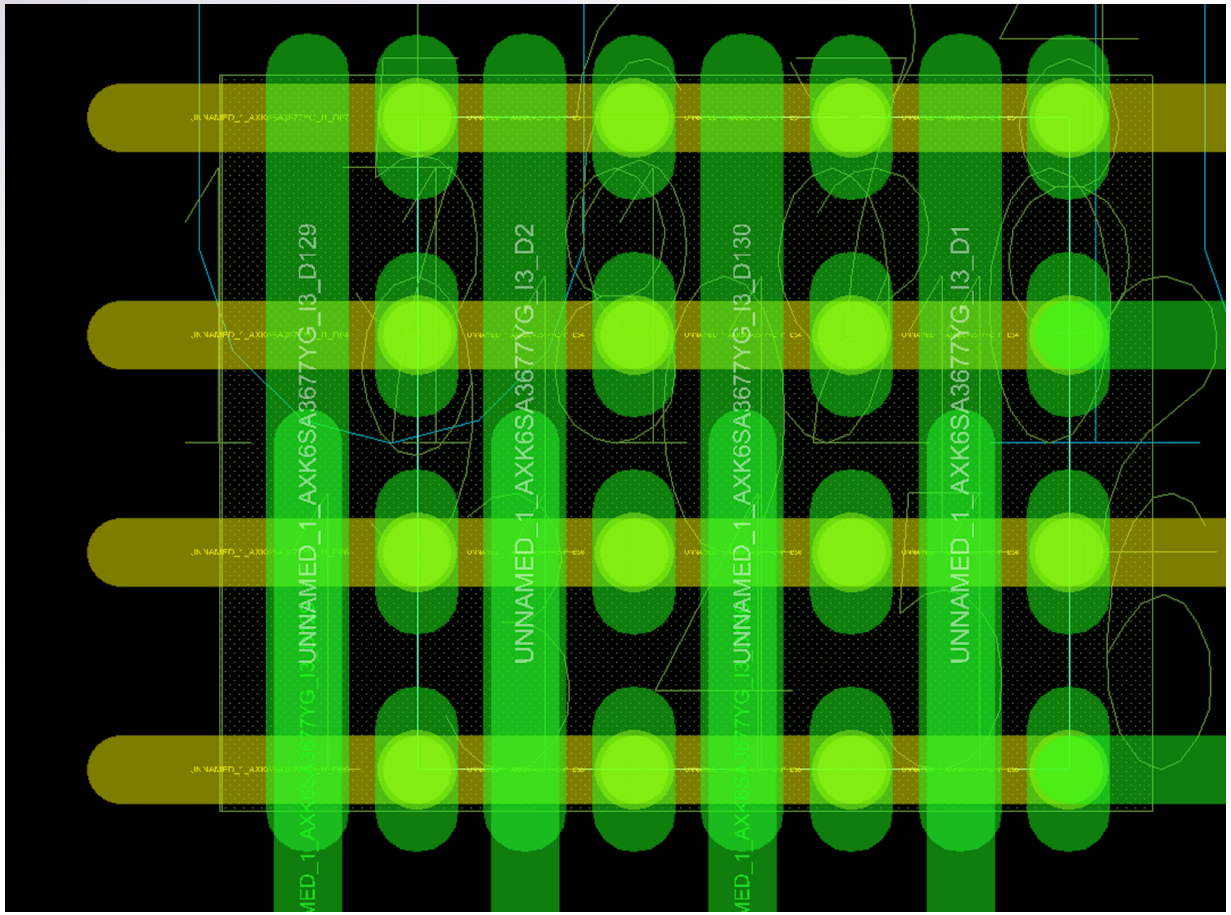
- Two different layouts:

  1) Strips (vertical) & Pads (horizontal)
  2) Strips of pads (vertical & horizontal) → **“Strads“**

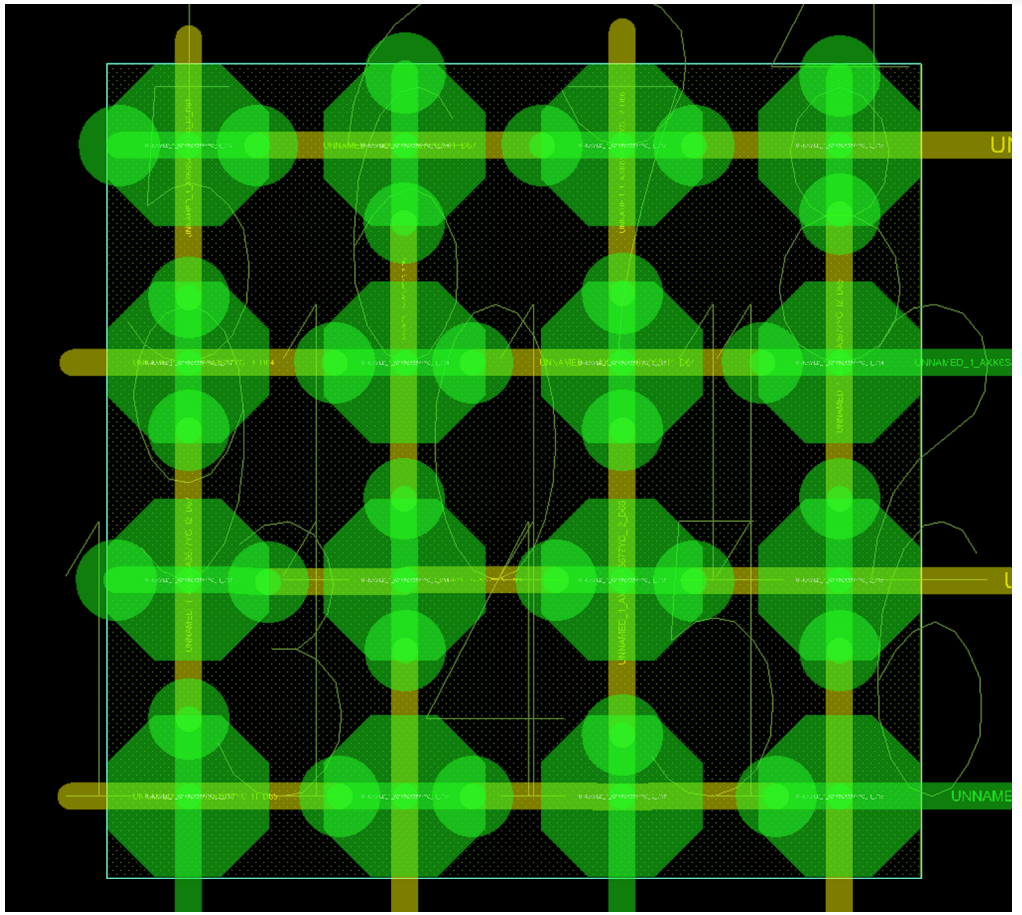
- Same pitch for both layouts: **400 µm** to achieve **50 µm resolution**
- Pads as oblongs or octagons → increase field homogeneity
- Connections of pads with tracks on the backside of the board
- Panasonic connectors (AXK6SA3677YG, **130 pins**)
- Guard-Rings as a field shield
- Designed in **Cadence Allegro** → Support from PRISMA Detector Lab

Cadence Allegro Sketches

Strips & Pads



Strads



Manufacturing plans

I. **10 x 10 cm^2 PCB prototype**
   - Test layouts
   - Measure energy resolution

II. **10 x 10 cm^2 foil prototype**
   - Transfer layout to a thin foil
   - Measure radiation thickness

III. **30 x 30 cm^2 PCB**
   - Enlarge first layout
   - Measure resolution
   - Observe electronics coupling

IV. **30 x 30 cm^2 foil**
   - Final test of all parameters

Testing plans

I. **Test with a ^{55}Fe source**

- Measure energy resolution
- Stability

II. **Test with cosmological radiation**

- Homogeneity of detector and readout electronics

III. **MAMI test-beam**

- High rates
- Position resolution

Open questions

- Can all tests be done with existent GEM detector?
- Do we need a new prototype?
- Prototype where PCB can be changed easier, e.g. build in cover?
- Make familiar with existent GEM detector?
- Start preparing tests?

Schedule & Outlook

- Order PCB prototype boards until end of February
- Test-beam: April 19-20
- PRISMA support until October
- End of master thesis: **November 3, 2017**

SFB 1044

PRISMA

THANK YOU FOR YOUR ATTENTION!

http://magix.kph.uni-mainz.de

Massachusetts Institute of Technology

University of Ljubljana

Westfälische Wilhelms-Universität Münster

Johannes Gutenberg Universität Mainz

JG|U