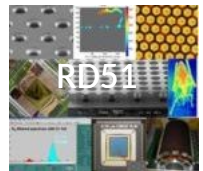
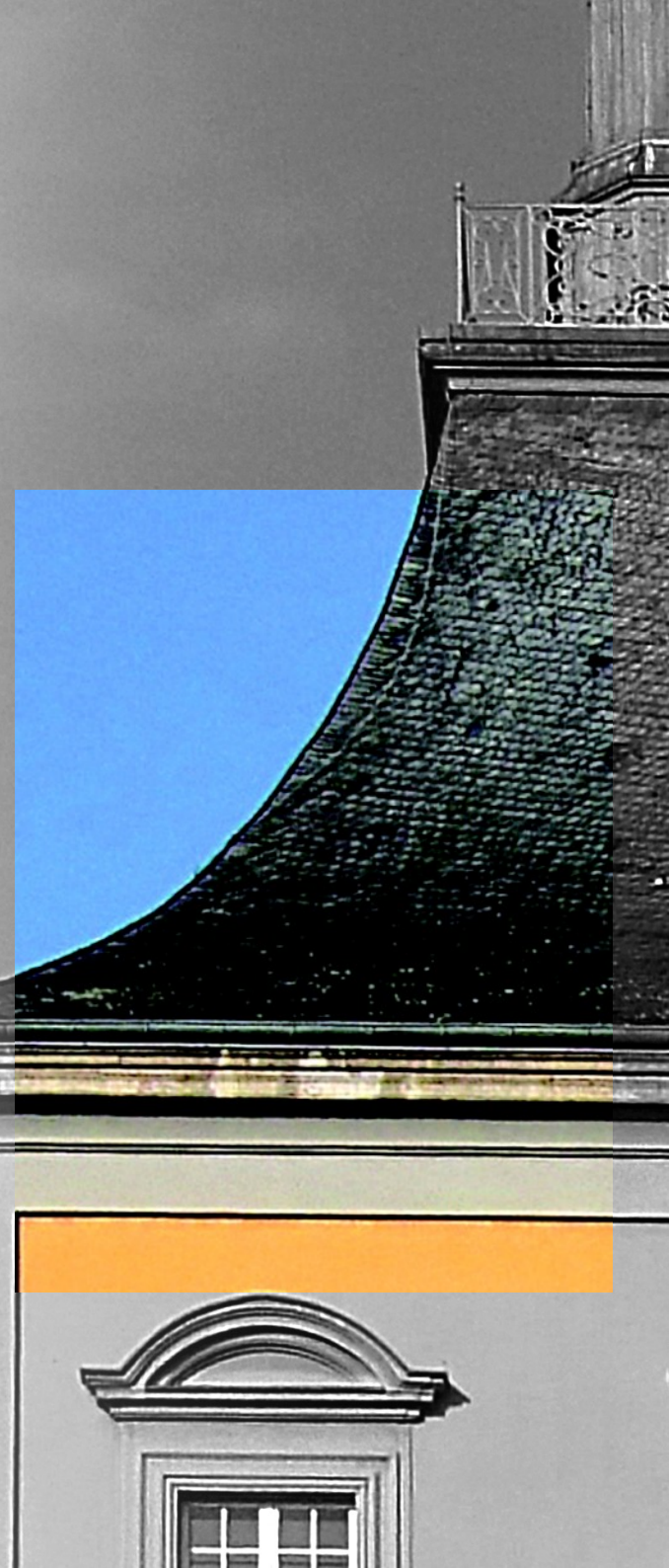




GEM upgrade for COMPASS++/AMBER

Michael Lupberger
(University of Bonn)
with material from Karl Jonathan Flöthner

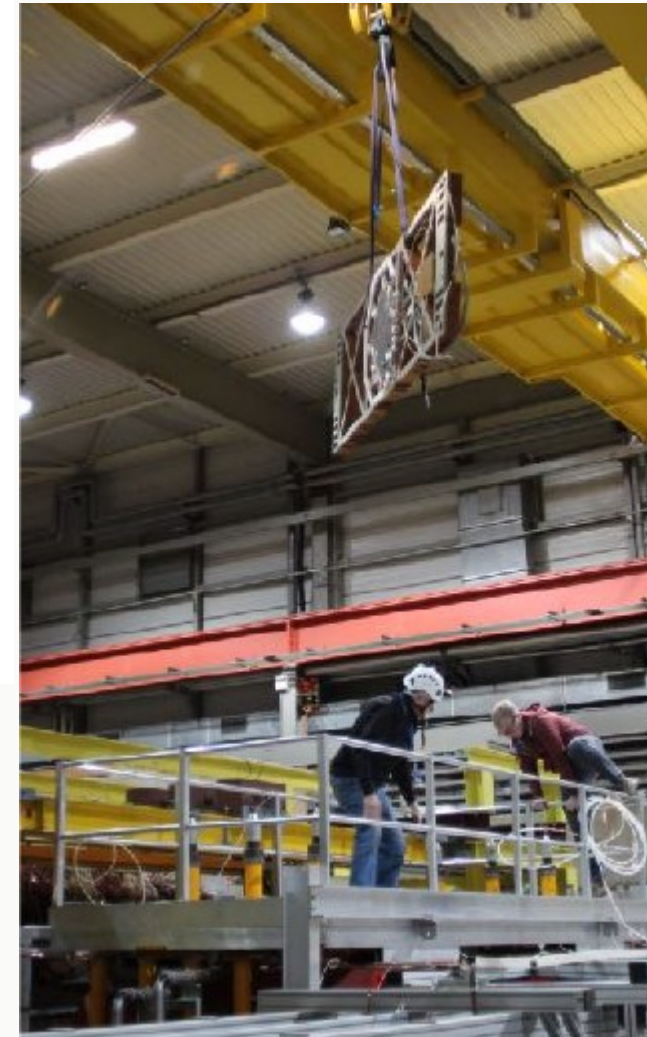
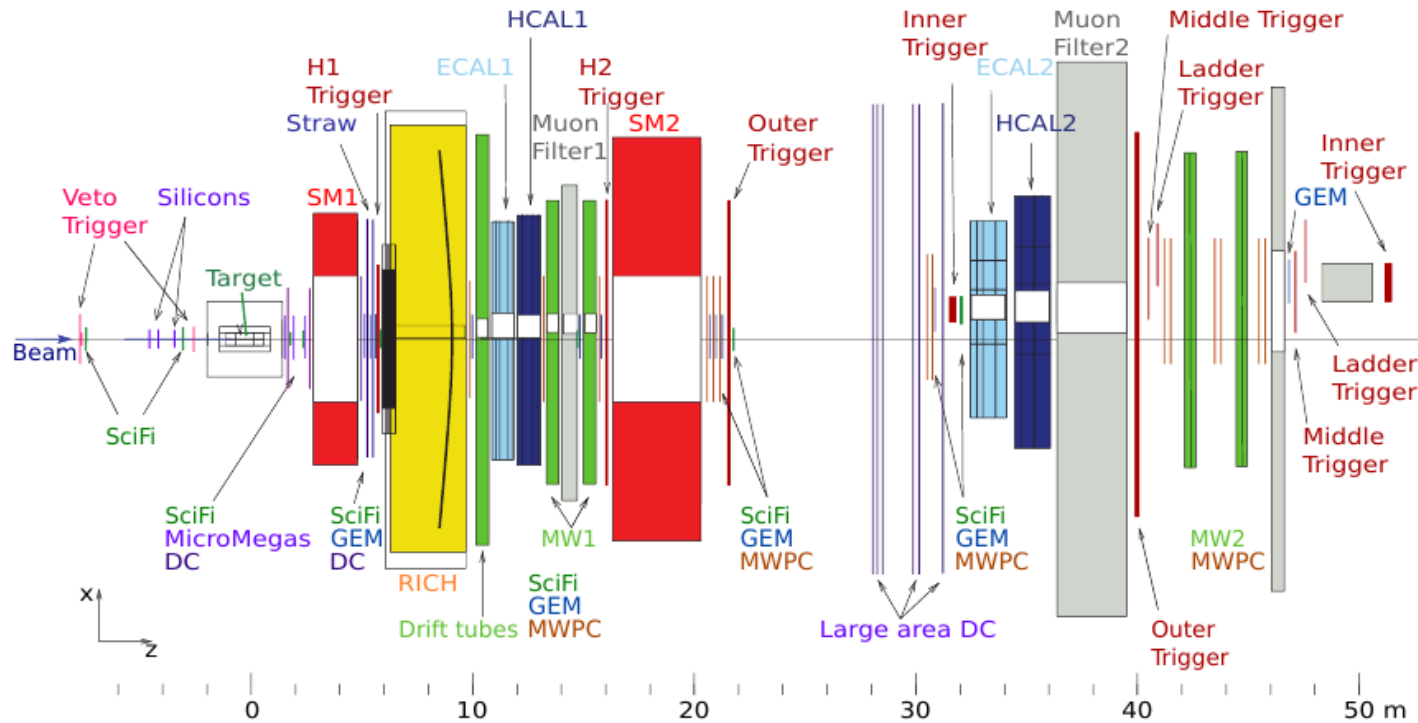
RD51 Miniweek 2021
19.02.2021



- Apparatus for Meson and Baryon Experimental Research:
- In the context of CERN's *Physics Beyond Collider* initiative
 - Proposal for a
New QCD facility at the M2 beam line of the CERN SPS
 - **LOI**: June 2018; Submitted to SPSC January 2019
 - **Proposal** for Phase 1 to SPSC: June (update Sept.) 2019
 - Physics program recommended by SPSC :October 2020
 - approval by CERN Research Board; December 2020

⇒ Upgrade + additions to existing COMPASS setup e.g.
→ New GEM detectors (high rate, continuous readout, ...)
+ final COMPASS run: need to replace 4 old GEM detectors

GEMs in COMPASS

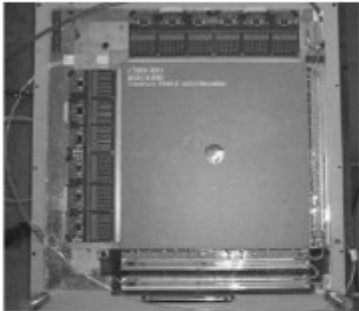


22 large GEM (30x30 cm²) from 2000
 5 Pixel-GEM (10x10 cm²) from 2008
 Readout ASIC: APV25

Progression

Of CompassGemGenerations

CG1G

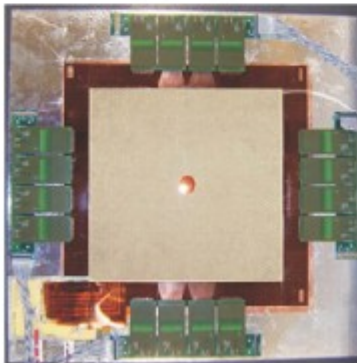


Large-size GEM

2001

2008

CG2G

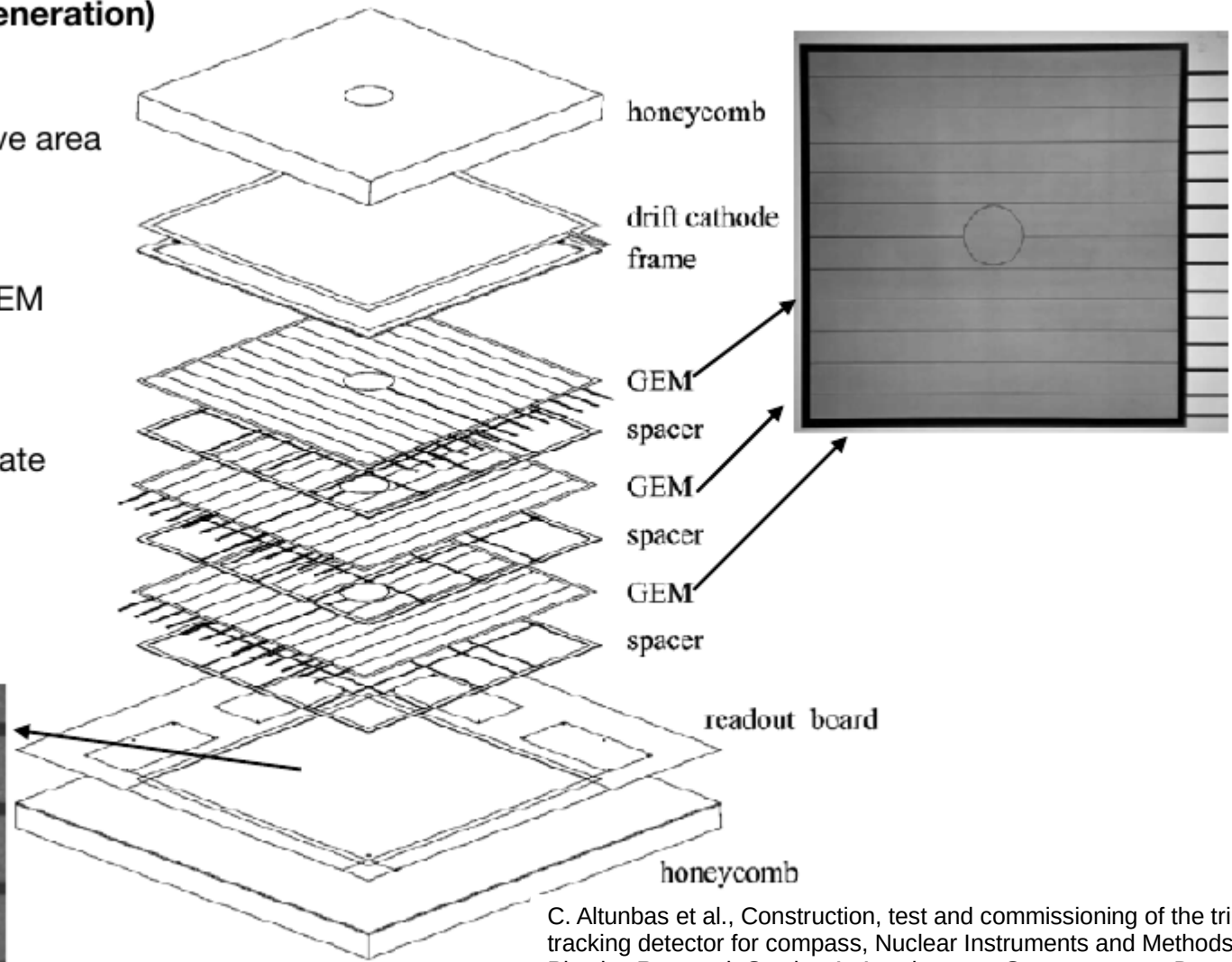


Pixel GEM

CG1G (large GEMs from 2001)

1st generation large-size GEM (Compass GEM 1st Generation)

- 30.7 cm x 30.7 cm active area
 - Continuous strips
- 13-fold top-sectored GEM
- Spacer frame with grid
- Gas-inlet via support plate
- Honeycomb plates

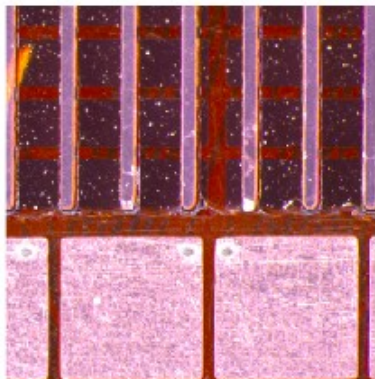


C. Altunbas et al., Construction, test and commissioning of the triple-gem tracking detector for compass, Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment 490 (2002) 177, issn: 0168-9002, url: <http://www.sciencedirect.com/science/article/pii/S0168900202009105>

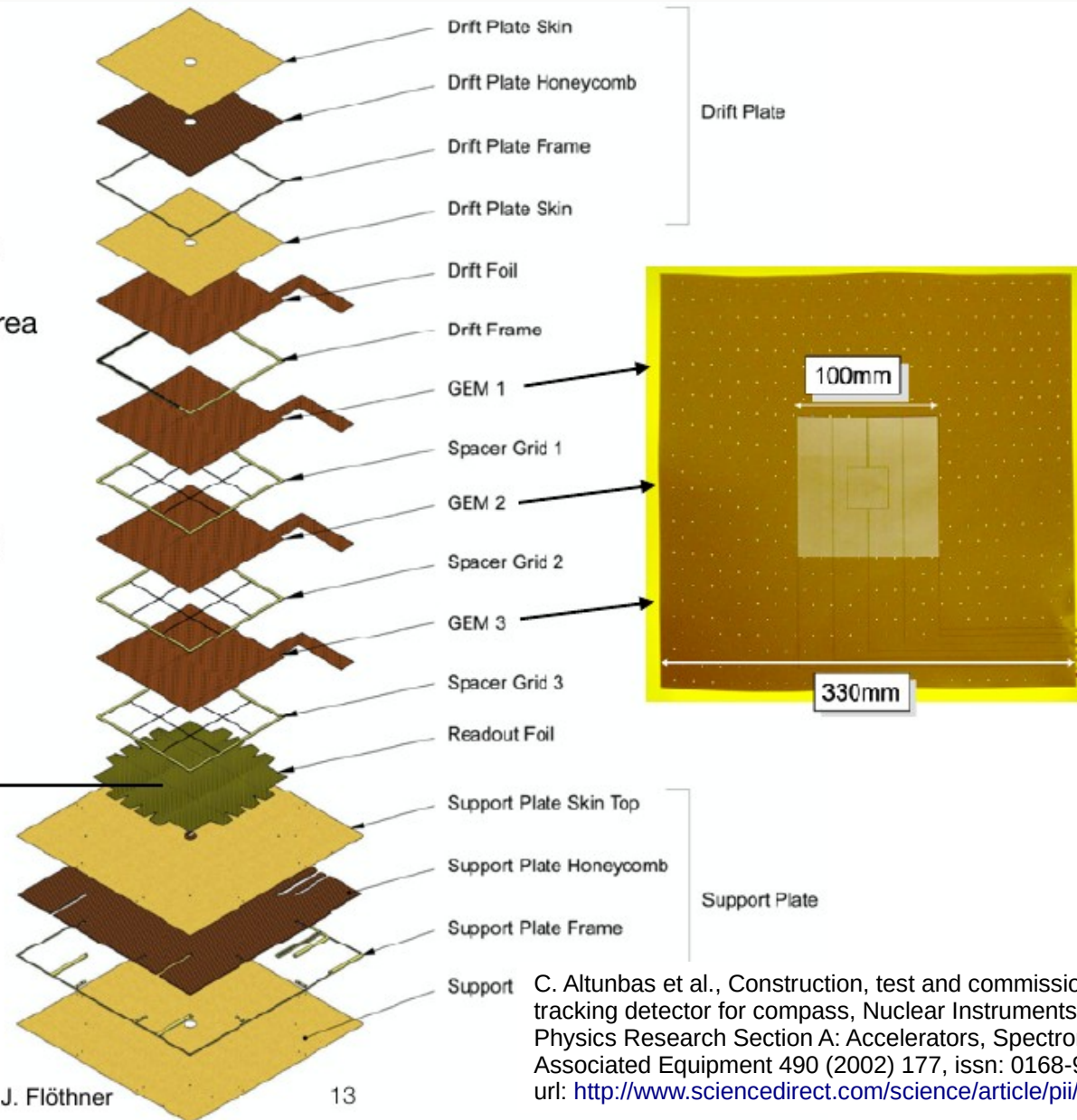
CG2G (Pixel GEMs form 2008)

PixelGEM (CG2G)

- 10 cm x 10 cm active area
 - 3.2 cm x 3.2 cm pixel area
- 5-fold top-sectored GEM
- Spacer with grids
- Gas-inlet via support plate
- Honeycomb plates



COMPASS GEM DETECTORS - K. J. Flöthner

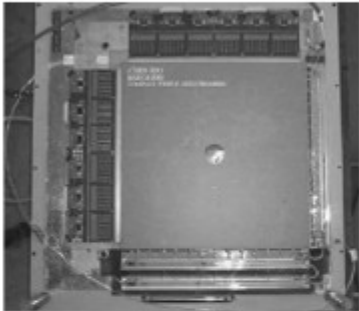


C. Altunbas et al., Construction, test and commissioning of the triple-gem tracking detector for compass, Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment 490 (2002) 177, issn: 0168-9002, url: <http://www.sciencedirect.com/science/article/pii/S0168900202009105>

Progression

Of CompassGem Generations

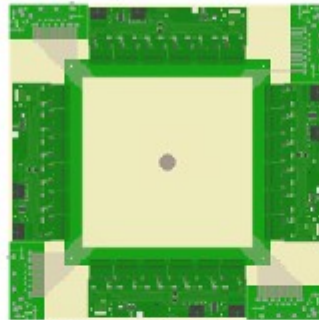
CG1G



Large-size GEM

2001

CG3G

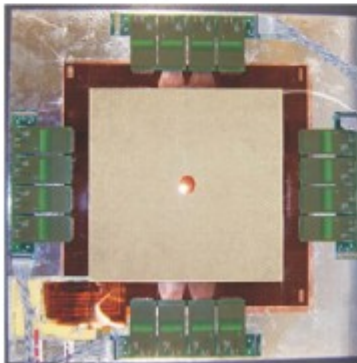


Updated Large-size

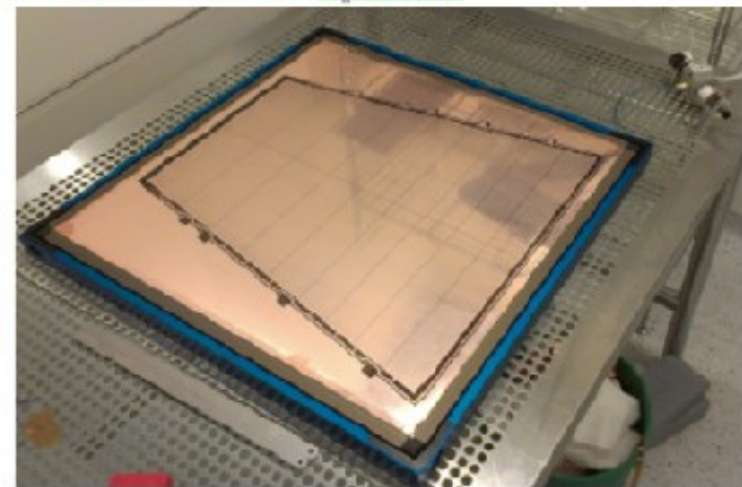
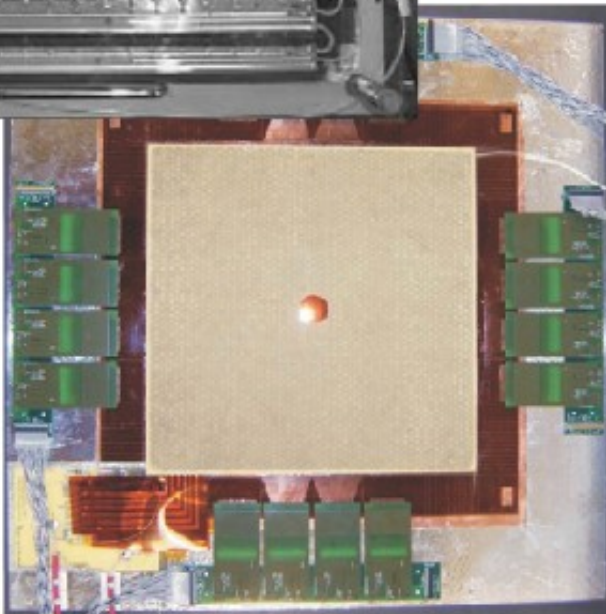
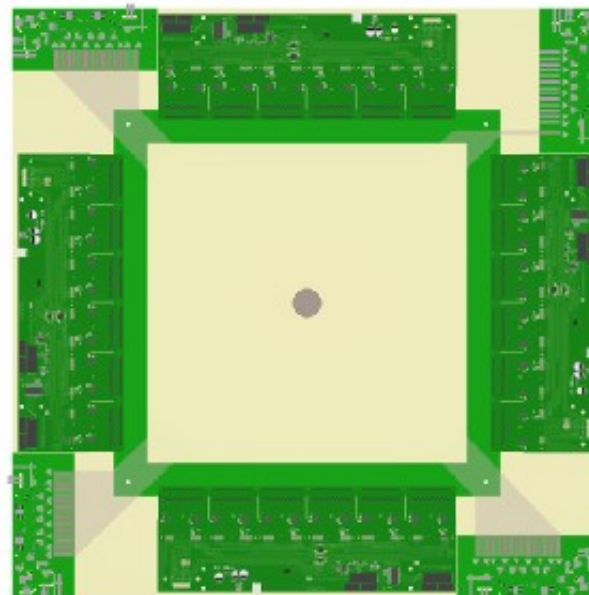
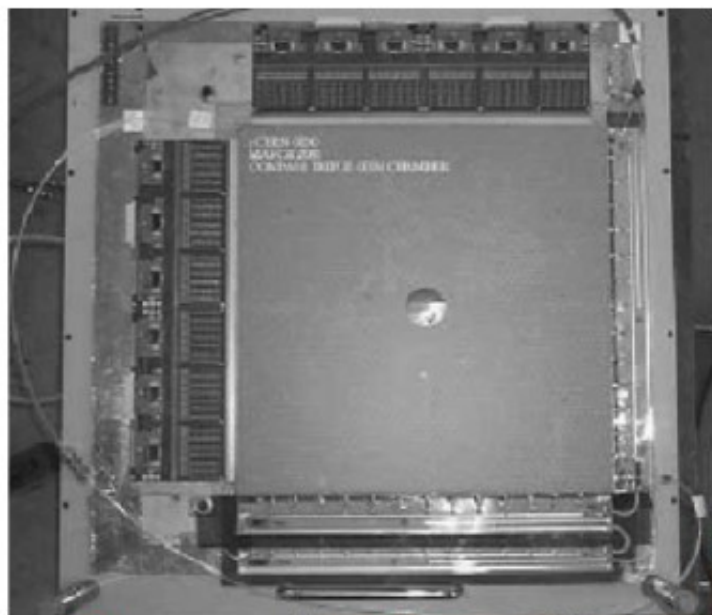
2021

2008

CG2G



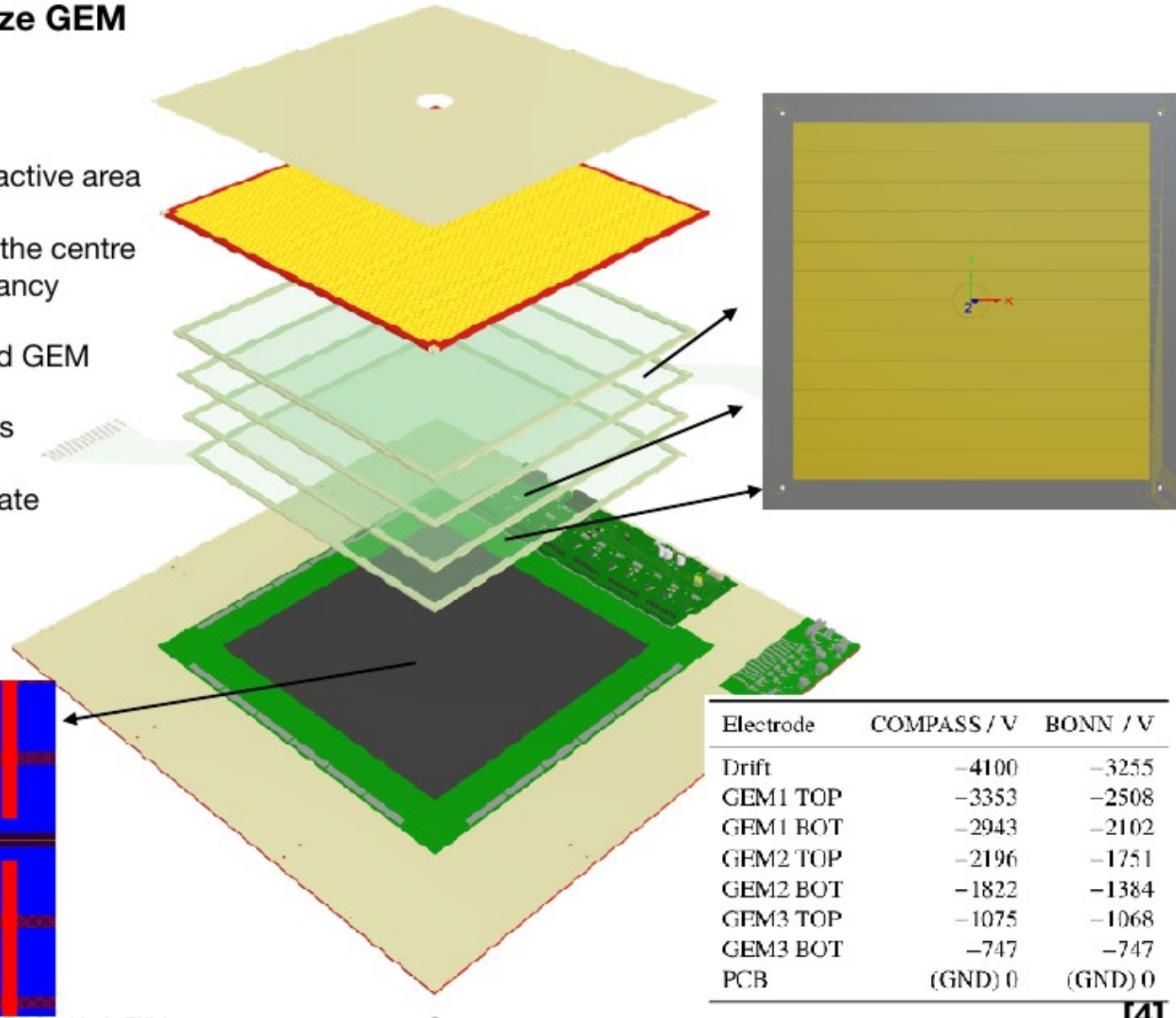
Pixel GEM



ALICE IROC GEM foil in stretching frame

Ongoing large-size GEM (CG3G)

- 30.7 cm x 30.7 cm active area
 - Strips divided in the centre to reduce occupancy
- 13-fold top-sectored GEM
- Spacer without grids
- Gas-inlet via drift plate
- Honeycomb plates

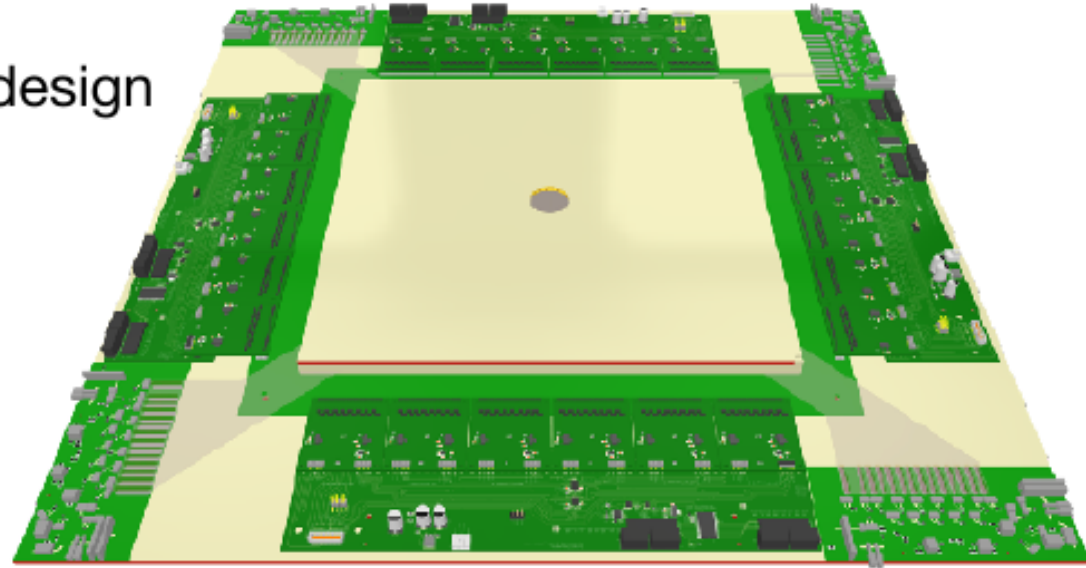


Electrode	COMPASS / V	BONN / V
Drift	-4100	-3255
GEM1 TOP	-3353	-2508
GEM1 BOT	-2943	-2102
GEM2 TOP	-2196	-1751
GEM2 BOT	-1822	-1384
GEM3 TOP	-1075	-1068
GEM3 BOT	-747	-747
PCB	(GND) 0	(GND) 0

TAT

Current Status

- New triple-GEM tracking detector design
- No spacer grids
- Cut strips without centre pixels (extendable in future)
- Avoid gas blocking due to rims
- Successful first test of the redesigned FE-electronics
- QA of foils ongoing
- Helpful knowledge from previous production & ALICE upgrade

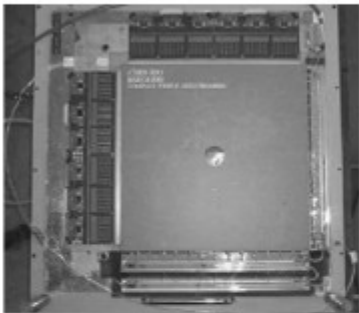


CG3G → CG4G → CG5G

Progression

Of CompassGemGenerations

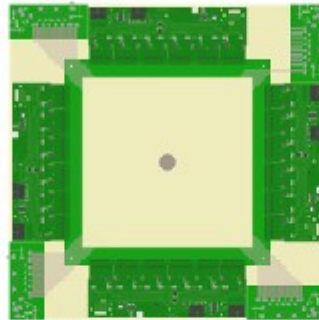
CG1G



Large-size GEM

2001

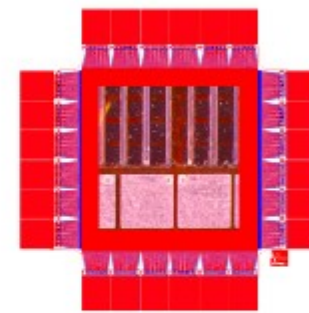
CG3G



Updated Large-size

2021

CG5G



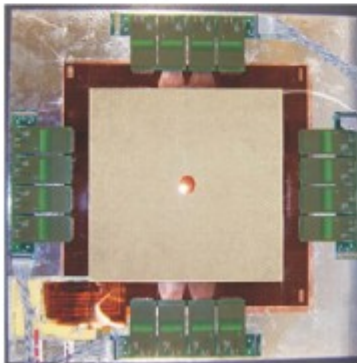
Large-size with Pixel

2023 - 2024?

not to scale

2008

CG2G



Pixel GEM

2022

CG4G



Self triggered readout

Planned measurements for beam times

We will have at least 2 brand new CG3G detectors in summer

- need to characterise in beam (mainly muons)
- Gain uniformity (no spacer grid → foil sagging?)
- Spacial resolution + uniformity
- Stabilised voltage divider (pions?)
- ...

Want to go towards CG4G (continuous readout)

- VMM/TIGER readout test → GDD/Lucian
- Use one of these ASICs also for detector characterisation
- Likely: no APV readout (COMPASS APV DAQ needed)

Required infrastructure

- Space: not too much, but in GEM beam telescope (VMM??)
+ possibility to remotely x-y move detector at best in telescope
- Gas: Ar/CO₂ 1 line/detector
- HV: 1 line/detector for new stabilised voltage divider
- DAQ: our own (SRS), requires Gigabit Ethernet to hut
- Support needed: GEM tracker setup + operation
+ later for GEM tracker reference in analysis
Lucian, Karl are based at CERN

Interest in both beam times

Scope of Cooperation

- Simulations & GEM production optimization (J. Ottnads HV-settings & ALICE experience)
- Self triggered readout:
 - VMM (M. Lupberger - Bonn, L. Scharenberg - CERN)
 - TIGER (Torino)
- Front-end design (C. Honisch - Bonn)
- Production: FTD (Bonn) and/or CERN
- ADCs and DAQ (I. Konorov - TUM)
- (VonRoll for mass production of frames)
- (Piekenbrink Composite GmbH for Honeycomb Plates)



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