

# Status GEM Detectors

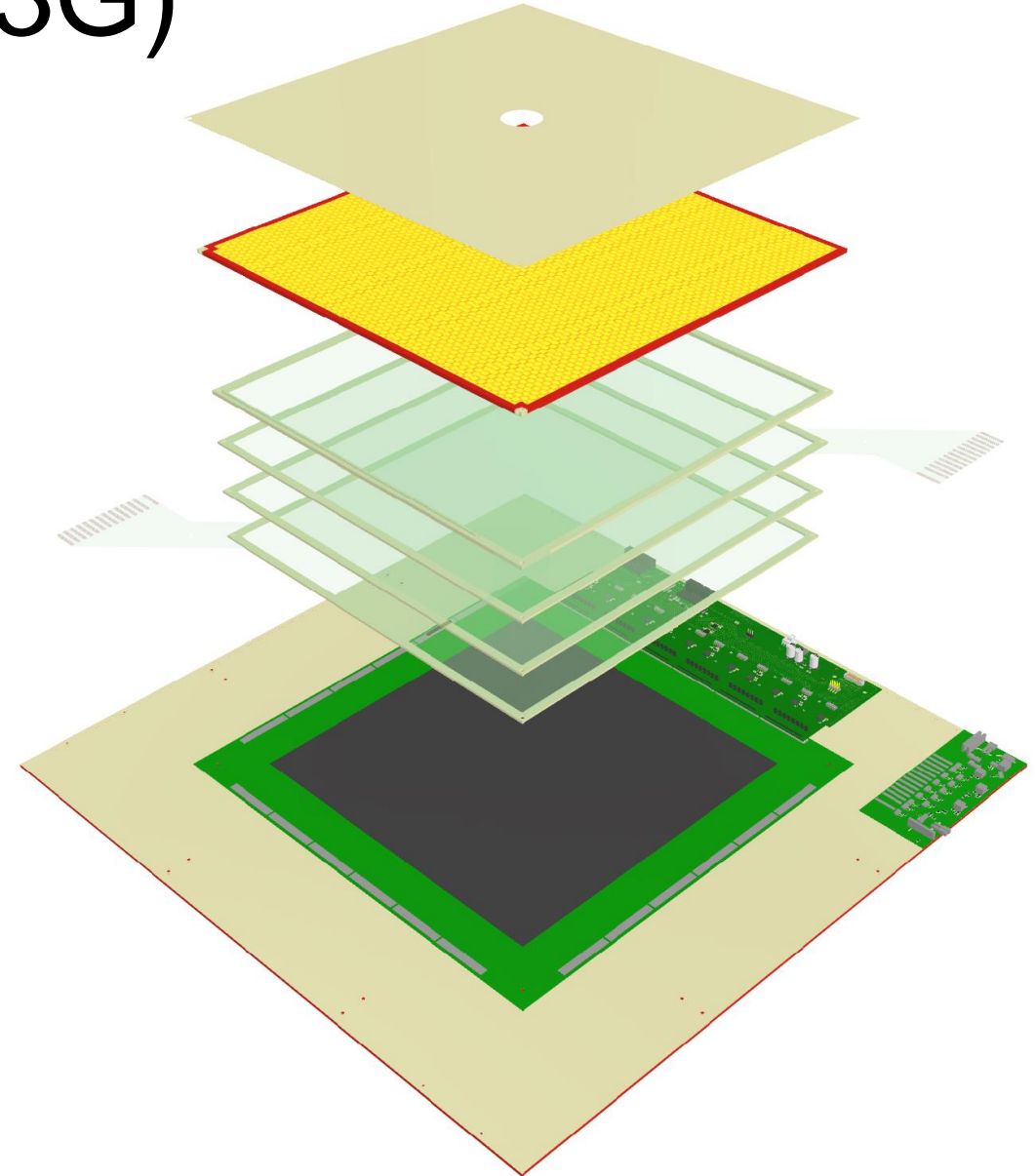
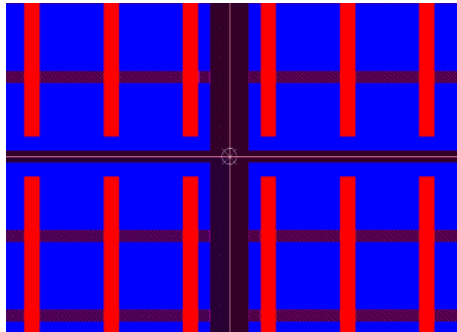
Dmitri Schaab / Bernhard Ketzer

COMPASS/AMBER Technical Board

08.02.2022

# COMPASS GEM-3G (CG3G)

- Size of active area:  $30.7 \times 30.7 \text{ cm}^2$
- Strips divided in center to reduce occupancy
- Triple GEM, foils sectorized on top (13 sectors)
- No spacer grids
- Gas in/out on drift plate, internal distribution



- Stabilized voltage divider: 3 +1 cards
- $6 \times 4$  front-end cards, 4 supply cards (bus cards)

# Status of detector parts (drift foils + GEMs + R/O-foils)

- CERN Batch 1: shipped 20.10.2020
    - 6 GEM foils (2 $\mu$ m Cu)  $\Rightarrow$  1 bad (high current), 5 good
    - 3 drift foils (2 $\mu$ m Cu)  $\Rightarrow$  3 good
    - 2+1 R/O foils  $\Rightarrow$  3 good
  - CERN Batch 2:
    - 10 GEM foils (2 $\mu$ m Cu), shipped 30.8.2021  $\Rightarrow$  1 bad (high current), 7 good, 2 not yet tested
    - 2 drift foils (2 $\mu$ m Cu), shipped 30.8.2021  $\Rightarrow$  2 good
    - 2+1 R/O foils, shipped 27.10.2021  $\Rightarrow$  2 good, 1 bad (known)
  - CERN Batch 3: ordered  $\Rightarrow$  to be finished by end of February
    - 7 GEM foils (minor design improvements)
    - 1 drift foil
    - 1 R/O foil
- **GEMs:** 12 good + 2 unknown + 7 ordered  $\Rightarrow$   **$\geq$ 6 detectors**
- **Drift:** 5 good + 1 ordered  $\Rightarrow$  **6 detectors**
- **R/O:** 5 good + 1 ordered  $\Rightarrow$  **6 detectors**

# Status of Production

- **Honeycomb plates** (Piekenbrink)
  - Batch 1a: 2 drift plates, 2 R/O plates (potted, bent)  $\Rightarrow$  re-treated, flattened } **2 detectors (avail./spare)**
  - Batch 1b: 2 R/O plates (GFK frame)  $\Rightarrow$  good } **4 detectors (available)**
  - Batch 2: 2 R/O plates, 2 drift plates,  $\Rightarrow$  good } **2 detectors (ordered  $\rightarrow$  mid March)**
- **GEM frames** (local workshop):
  - full frame sets for 3 detectors available (drift, transfer, induction) } **3 detectors (available)**
  - 10 parts for 2.5 transfer frames available } **~2 detectors (backup material)**
  - spare material for segmented frames available }  **$\geq 6$  detectors (ordered  $\rightarrow$  mid March)**
  - ordered material for 10 drift frames + 20 transfer/induction frames
- **Currently:** Material for 5 detectors total (incl. backup material)
- **Mid March** (supply bottlenecks): Material for  $\geq 8$  detectors total
- **QA improved:** intersegment test automated (J. Paschek)
- **Production database** set up for COMPASS (taken over from ALICE / P. Glässel)

# Database for Production

- Stock keeping integrated
- QA steps/files included
- Trackable construction chain

## HISKP Compass production database, category Compass

link color code	serial no	barcode	unnumbered
prefix color code:	parent part	daughter part	both
part color code:	QA defined		

link	category	part	batch	type	prefix	ordered	sent	unnumbered stock at institutes		numbered stock		
								Bonn	used	inventory	finished	used
X	Compass	Drift foil			CD3G-nn					5		1
X	Compass	Drift frame	1		D-frame			2				
X	Compass	Drift GEM			GM1-nn							1
X	Compass	Drift plate			DP-nn							1
X	Compass	GEM foil			CG3G-nnn					13		3
X	Compass	GEM stack			GMS-nn							1
X	Compass	honeycomb plate large	1		HCL			1				
X	Compass	honeycomb plate large	2		HCL			3				
X	Compass	honeycomb plate small	1		HCS			1				
X	Compass	honeycomb plate small	2		HCS			1				
X	Compass	intermediate frame	1		I-frame			4		2		
X	Compass	intermediate GEM			GM2-nn							1
X	Compass	R/O foil			CR3G-nn					5		1
X	Compass	R/O frame	1		R-frame			2				
X	Compass	R/O GEM			GM3-nn							1
X	Compass	R/O plate			RP-nn							1
X	Compass	readout chamber			G3Mnn					1		

Item G3M/G3M01 (batch 1) contains (only next level):

part	type	prefix	num	serialno	batch	date	status	link	comment
GEM stack	GMS	0	GMS-01	1	2022-01-28		X		
R/O plate	RP	0	RP-01		2022-01-28		Δ		

[define/modify contained parts](#)

Item GMS/GMS-01 (batch 1) contains (only next level):

part	type	prefix	num	serialno	batch	date	status	link	comment
Drift plate	DP	0	DP-01		2022-01-28		X		
Drift GEM	GM1	0	GM1-01	1	2022-01-28	0	X		
intermediate GEM	GM2	0	GM2-01	1	2022-01-28	0	X		
R/O GEM	GM3	0	GM3-01	1	2022-01-28	0	Δ		

[define/modify contained parts](#)

Item GM2/GM2-01 (batch 1) contains (only next level):

part	type	prefix	num	serialno	batch	date	status	link	comment
GEM foil	CG3G	0	CG3G-003	1	2022-01-28	2	X		

[define/modify contained parts](#)

step (link)	status	data field (hover cursor for explanations)	value	n	date	QA step/file comment	author	condition	true?
1	1	quick defect map	<a href="#">defectmap.txt</a> <a href="#">show</a>		2022-01-25 11:22:26	ok 0 0 0 2 defects	Karl	file txt	
2	2	HV cleaning	done	2	2022-01-26 13:21:07		Karl	eq done	
3	3	intersegment test						eq ok	
6	6	leakage current [pA] at 500 V	15		2022-01-26 13:32:27		Karl	<= 167	
7	7	spark map	<a href="#">do the spark map</a>					file txt	
8	8	absolute humidity [ppmV]	2800		2022-01-26 13:32:27		Karl	<= 6000	
9	9	spark map upload	Upload datafile: Datei auswählen Keine Datei ausgewählt upload file <b>after choosing file!</b>			file comment: <input type="text"/>		file ok	
10	QA-B	I_leak histo data	<a href="#">06_CG3G_01_03_N2_framed_corrected.txt</a> <a href="#">evaluate</a>		2022-01-26 13:31:59	no comment	Karl	file txt	
15	QA-A	long term leakage current data	<a href="#">04_CG3G_01_03_N2_longterm_corrected.txt</a> <a href="#">evaluate</a>		2022-01-26 13:31:41	no comment	Karl	file txt	
20	20	frame glueing	ok	3	2022-01-26 13:33:12		Karl	eq ok	
25	25	quality	A		2022-01-26 13:32:36		Karl	le C	

# Status of Stabilized Voltage Divider (SVD)

- Single channel stabilized voltage divider (test):
  - 3 PCBs in use, one as **P**assive **V**oltage **D**ivider (PVD)
  - Calibration done  $\Rightarrow$  voltage measurement working
  - Next Step: Test with detector  $\Rightarrow$  measure gain stability (B. Roth/Bachelor)
  - 5 more PCBs ordered  $\Rightarrow$  to be assembled
- Detector scale stabilized voltage divider
  - updated version with minor fixes ready to be ordered, once needed
  - HV cable between SVD boards  $\Rightarrow$  flex PCB (prototypes available)
- Passive voltage divider (PVD)
  - New PCBs in use, a few spare PCBs available
- Measurements / simulations with SVD/PVD ongoing
  - $\Rightarrow$  results expected by end of February (C. Honisch, B. Roth)
- See also: Talk on SVD by C. Honisch - RD51-Meeting 07.02.2022

# Status of detector production

	Support plates	Frames	Drift foil	GEM foils	Readout PCB	HV board	Assembly	Calibration	Installation
CG3G01	✓	✓	✓	✓	✓	SVD	✓	✓	Prototype
CG3G02	✓	✓	✓	✓	✓	PVD	GAS		
CG3G03	✓	✓	✓	✓	✓		QA		
CG3G04	✓	ordered / spare material	✓	✓	✓		QA		
CG3G05	ordered / spare material		✓	ordered / spare material	✓				

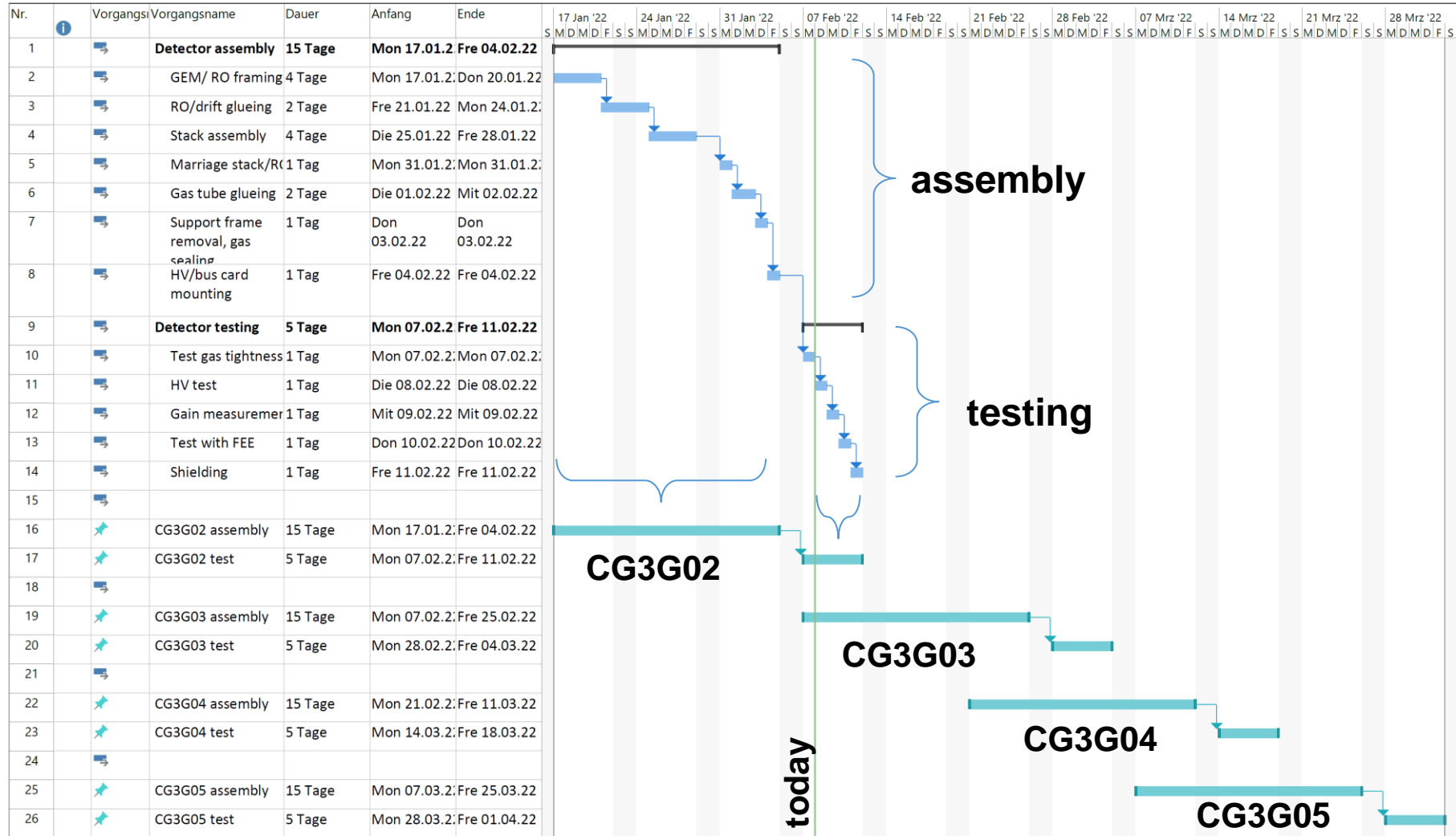
## Assembly steps:

- QA: quality assurance
- G1, G2, G3: GEM i framed
- RO: R/O PCB glued
- D: drift foil glued
- S1, S2, S3: stack i glued
- DET: detector assembled
- GAS: gas pipes + tight
- HV: HV board assembled

Stations to be replaced for 2022: GM05, GM08 (GM04?)

Installation: April/May 2022

# Timeline



Projekt: cg3g\_production\_2022  
Datum: Die 08.02.22

Vorgang		Inaktiver Vorgang		Manueller Sammelrollup		Externer Meilenstein	
Unterbrechung		Inaktiver Meilenstein		Manueller Sammelvorgang		Stichtag	
Meilenstein		Inaktiver Sammelvorgang		Nur Anfang		In Arbeit	
Sammelvorgang		Manueller Vorgang		Nur Ende		Manueller Fortschritt	
Projektsammelvorgang		Nur Dauer		Externe Vorgänge			



# Front-end and readout electronics

- **Front-end cards (APV):**
  - APVs available for all detectors
  - 56 cards ready and tested (24 per det., 2 at TUM)
  - Components and PCBs for 100 cards available, some delay in assembly
- **Supply cards (bus cards):**
  - **2** produced and being tested (at TUM) / **6** PCBs in production  $\Rightarrow$  PCB + stencil + components available
  - bugfix for new PCBs: capacitor too high  $\Rightarrow$  add cut-outs
  - mating test with connectors to APV FE needs to be done  $\Rightarrow$  then ready to be assembled.
- **ADC cards:**
  - 2 produced, 1 working (at TUM), tested with IFTDC
  - **3rd** assembled (solder process optimized)  $\Rightarrow$  to be tested by I. Konorov
  - after successful test: assemble more PCBs / PCBs + components still to be provided
  - components for 10-15 cards available, 2 per det. needed, delay in assembly (Covid)
  - full system test with APV to be performed at CERN (DAQ lab)
  - 9 IFTDC cards produced
  - ADC firmware ported to Artix FPGA (S. Huber) / Slow control implemented in config\_server (V. Frolov)

# AMBER PRM readout requirements

**Starting point:** 30x30 cm<sup>2</sup> with **divided strips** and **active central sector / self-triggering VMM**

- Readout of all 4 sides (1 detector)
- 768 channels per side (1 detector)
- 2 detectors per station in 6 stations

## Requirements

- number of **channels per projection**:  $2 \times 768 = 1536$
- number of **projections per station**: 4
- number of **stations**: 6
- number of **bits per hit**: **38 raw** from VMM / **48** with additional **time stamp**
- **in progress**: amount of information produced by one projection for nominal PRM beam  
(conditions in streamed mode  $\Rightarrow$  noisy hits + induced by charged particles)