

Korean capability in MPGD production and μ RWELL ECT contribution plan

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EIC Asia Meeting

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1. CMS Phase-2 GEM upgrades

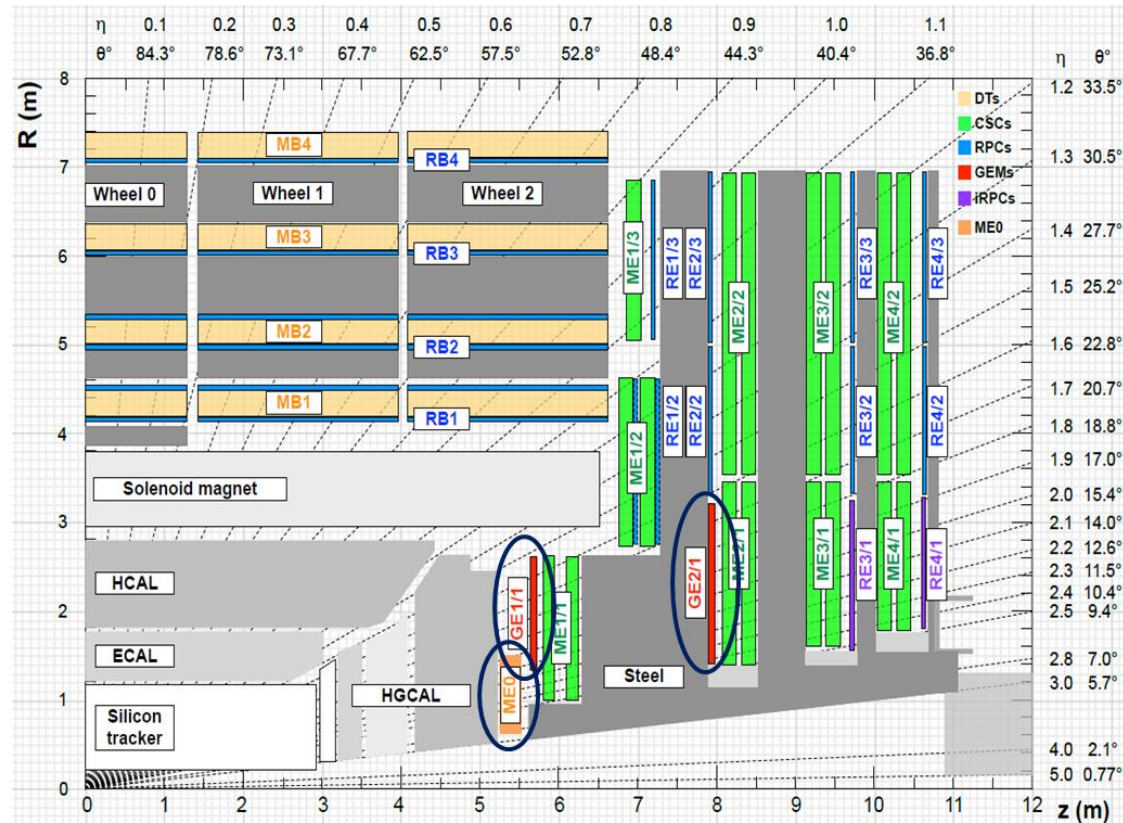
- Three GEM stations: GE1/1, GE2/1, and ME0
 - Too many GEM foils for CERN MPT to produce alone
- KCMS responsibility: production of half of GE2/1 and all of ME0 foils
 - ~ 1100 foils



Korea University (2007-)
 Kyungpook National University (2007-)
 Sungkyunkwan University (2007-)
 Chonnam National University (2007-)
 University of Seoul (2009-)
 Seoul National University (2013-)
 Faculties: B. Hong, S. Choi, J. Yoo
 Faculties: S.W. Lee, C. Moon
 Faculties: I. Yu
 Faculties: D. Moon
 Faculties: I. Park, J. Lee
 Faculties: U. Yang

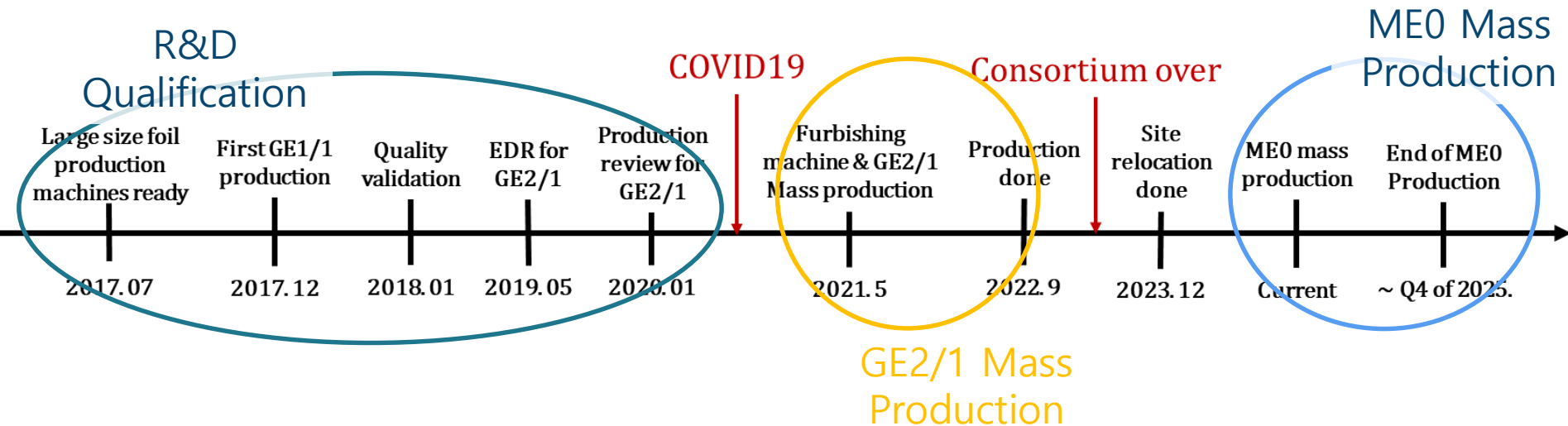
Sejong University (2015-)
 Hanyang University (2016-)
 Kyung Hee University (2019-)
 Yonsei University (2020-)
 Gangneung-Wonju National University

<https://www.cms-kr.org/>



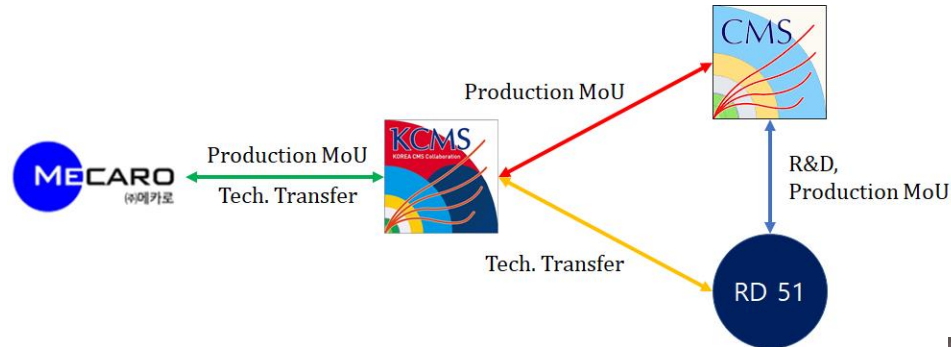
2. Timeline of GEM production in Korea – Overview

- KCMS is one of the only two vendors of large size GEM foils
 - The double-mask technique for faster production
 - Mask alignment is crucial
 - Maximum size: $120 \times 58 \text{ cm}^2$
- Glass mask (~15k USD) is needed



2. Timeline of GEM production in Korea – R&D

- KCMS had made consortium with Mecaro Co., Ltd.

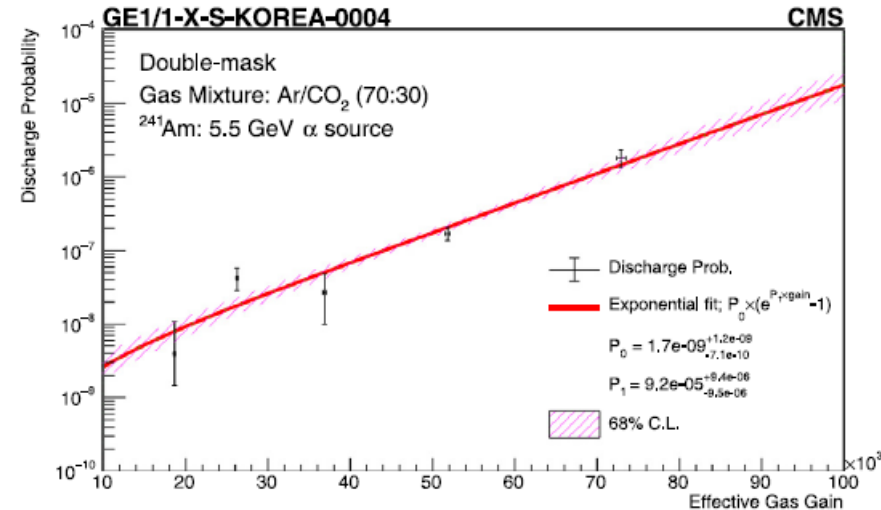
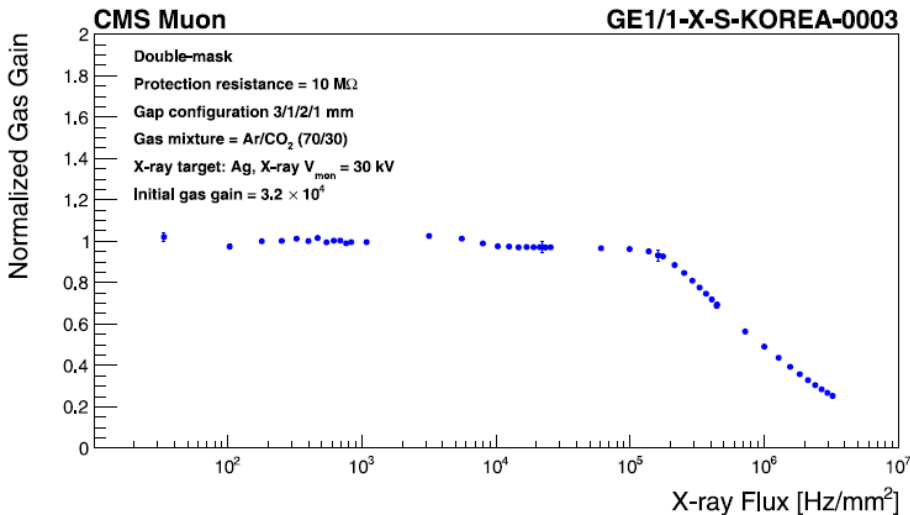
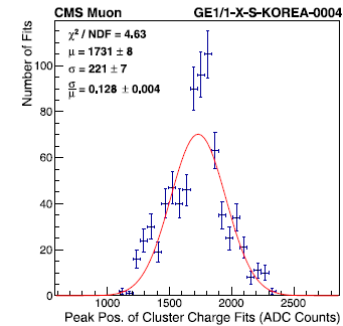
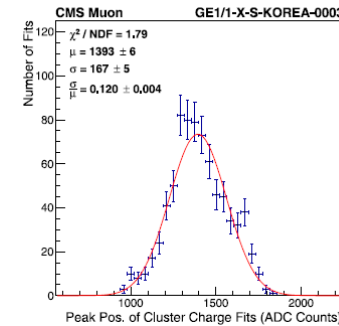
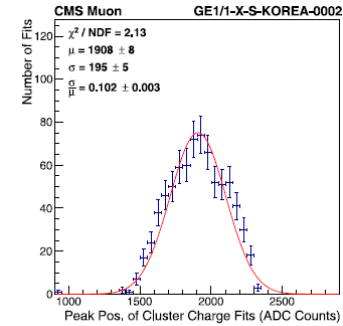
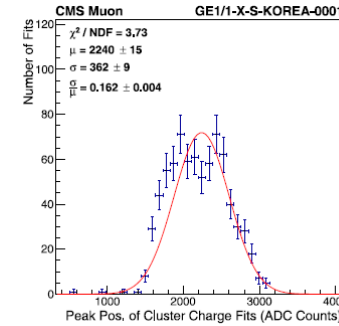
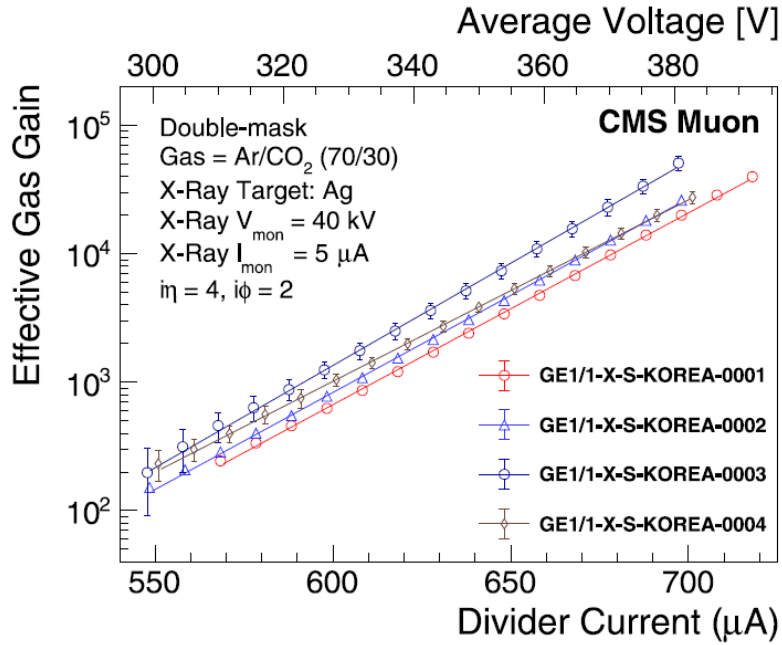


- Production R&D and vendor qualification were done with CMS GE1/1 detectors
- After optical and electric inspections, 4 GE1/1 detectors were assembled with Korean GEM foils and properties of those were measured
 - Results were consistent with CERN detectors and satisfied CMS TDR requirements
 - NIMA 1057 (2023) 168723



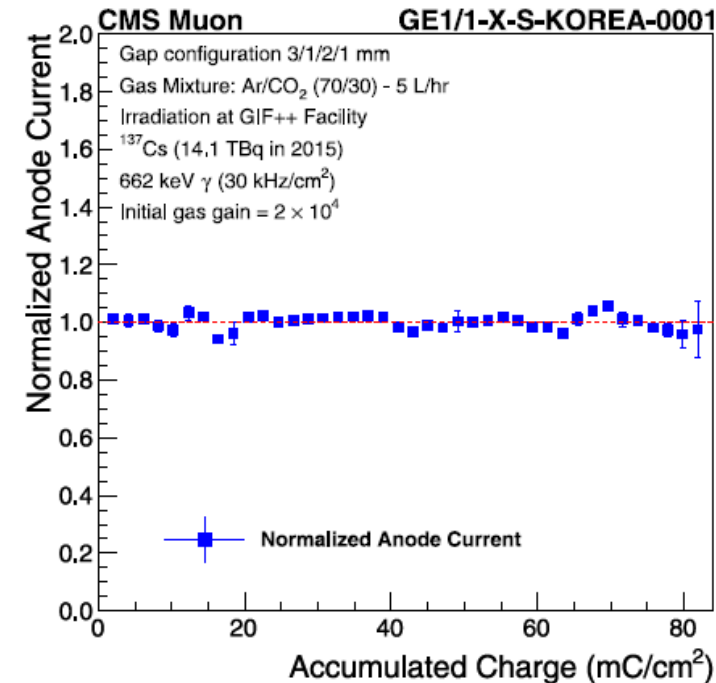
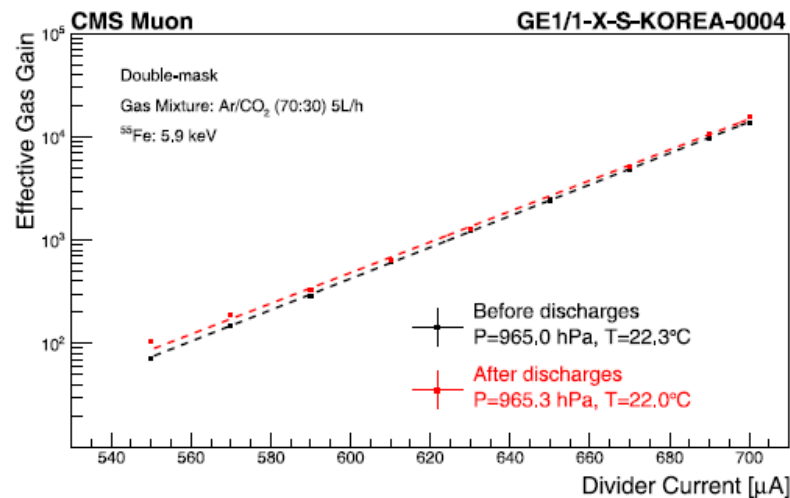
2017, Dec, 2nd₅
@ Geneva airport

2. Timeline of GEM production in Korea – R&D



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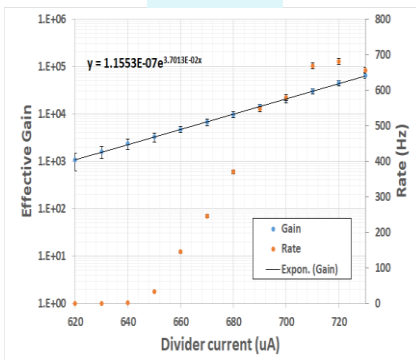
- Throughout the R&D phase, we've accumulated a lot experience not only in production R&D but also in detector R&D
 - Aging experiment @ UoS
 - Large pool of person power



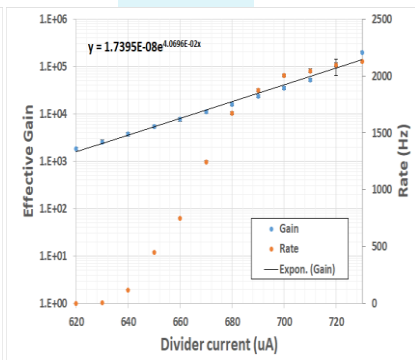
2. Timeline of GEM production in Korea – Mass production

- 292 foils have been produced and passed QC/QA criteria
 - From 2021 May to 2022 Sep.
- Experience in mass production has been accumulated

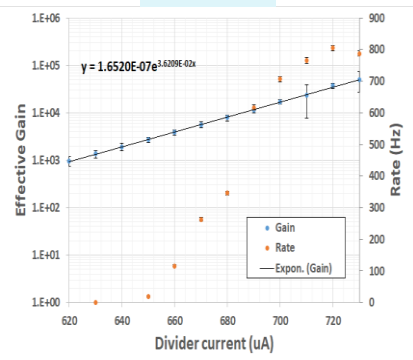
M2



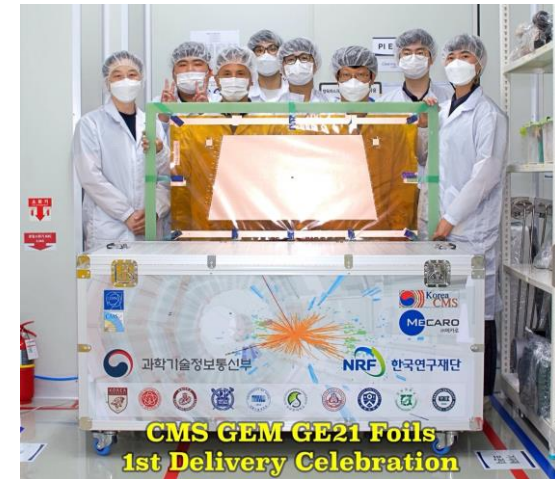
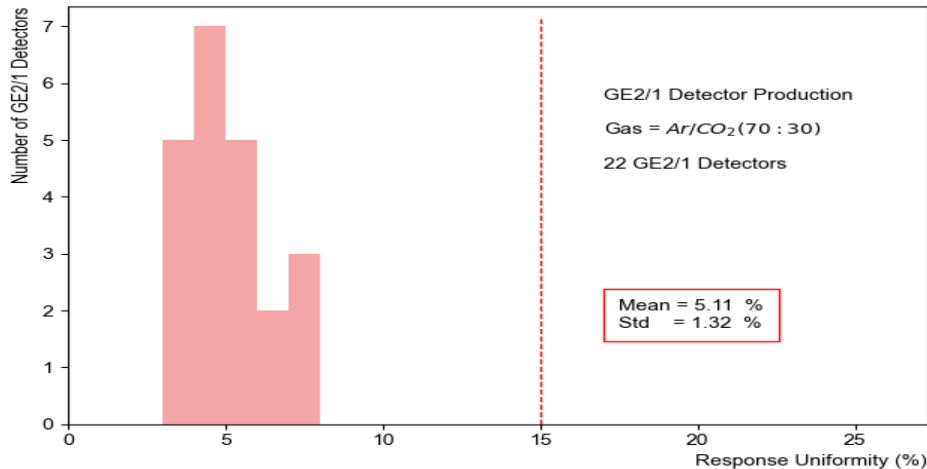
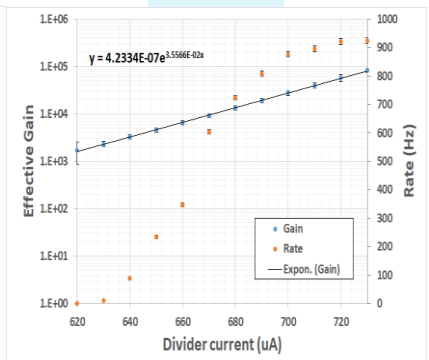
M3



M6



M7



2. Timeline of GEM production in Korea – Site relocation

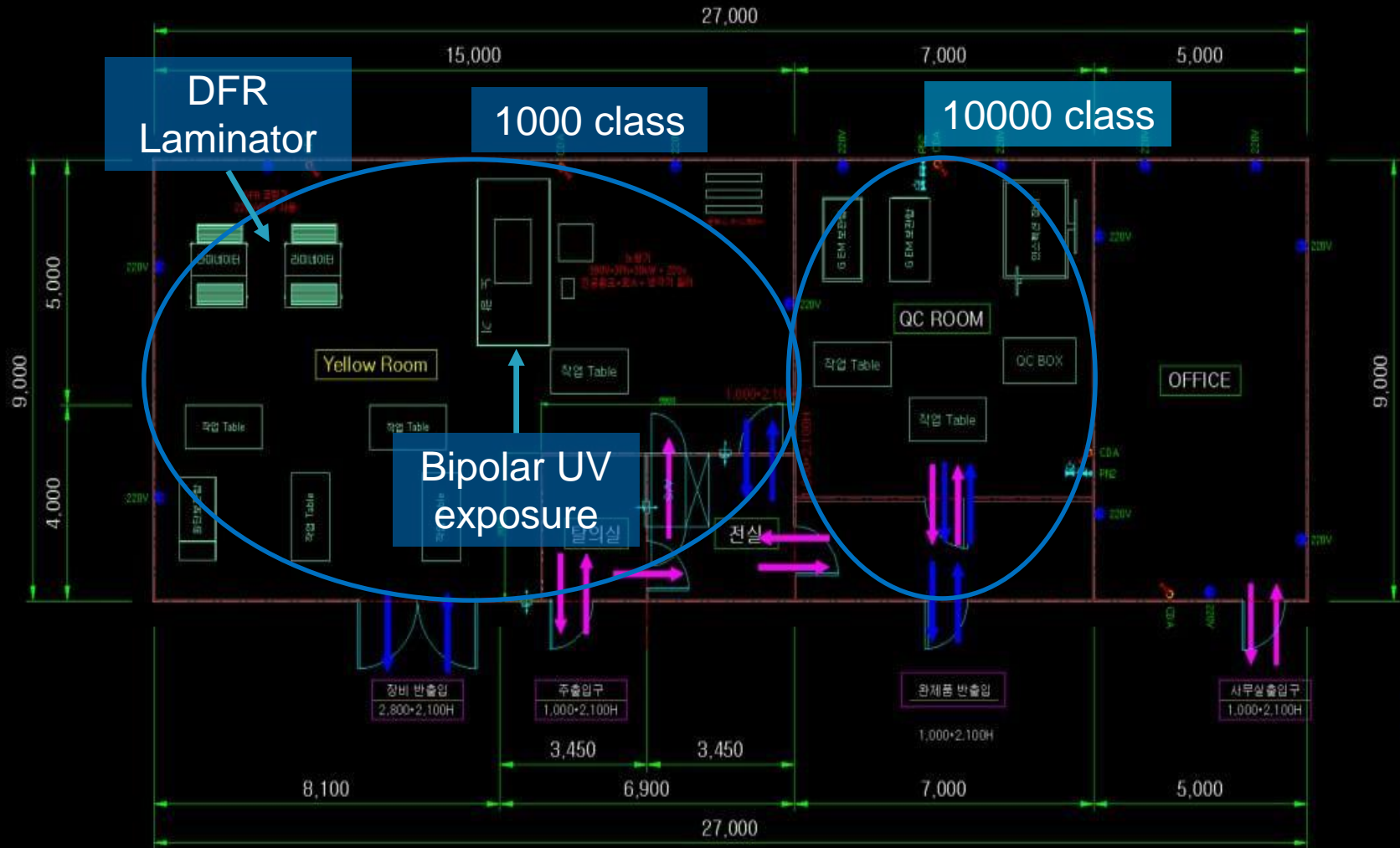
- Unfortunately, Mecaro gave up GEM production

New since last EIC Asia workshop @ RIKEN

- Photo process @ IBS, leading organization of “the Korean EIC”
Chemical process @ PnF Co. (PCB maker), site & technicians are rented
 - 2 h 30 min
 - Not possible to get chemical handling license in IBS area due to environmental regulation
- Site relocation & **green light ~ 2023. 12**
 - Validation batch was produced at the new site, Delivered to CERN and checked



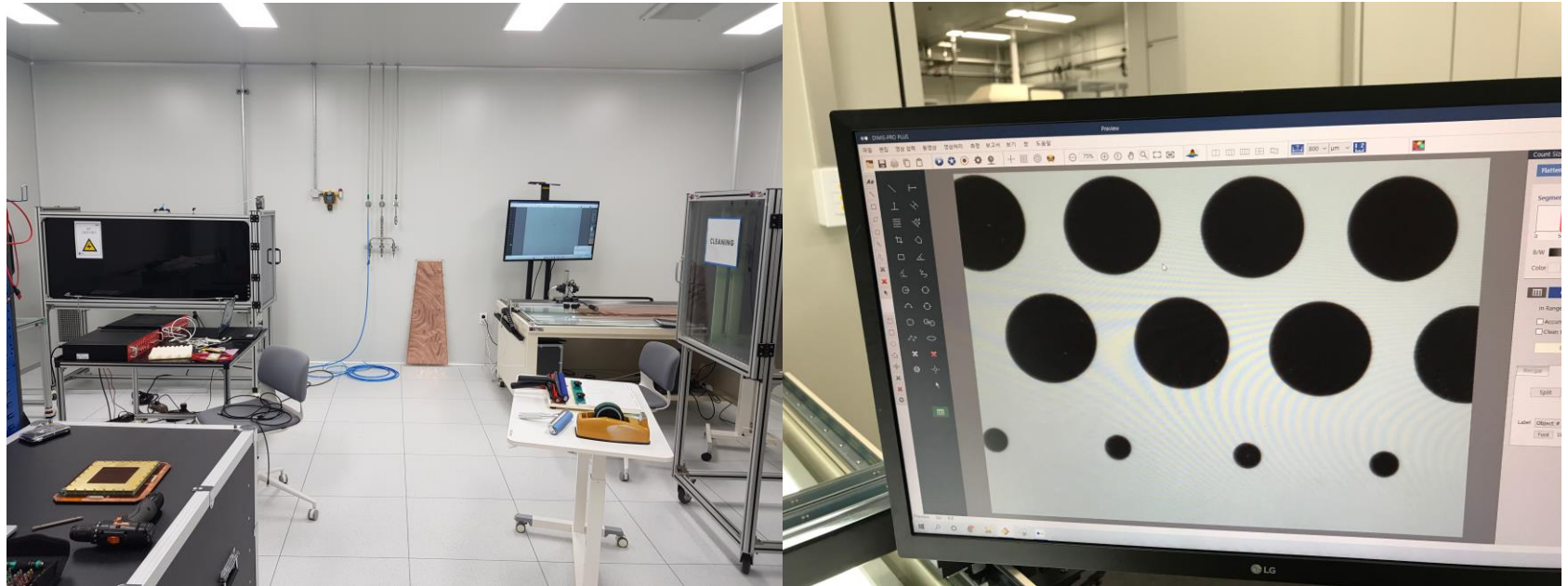
3. Facilities – Photo site



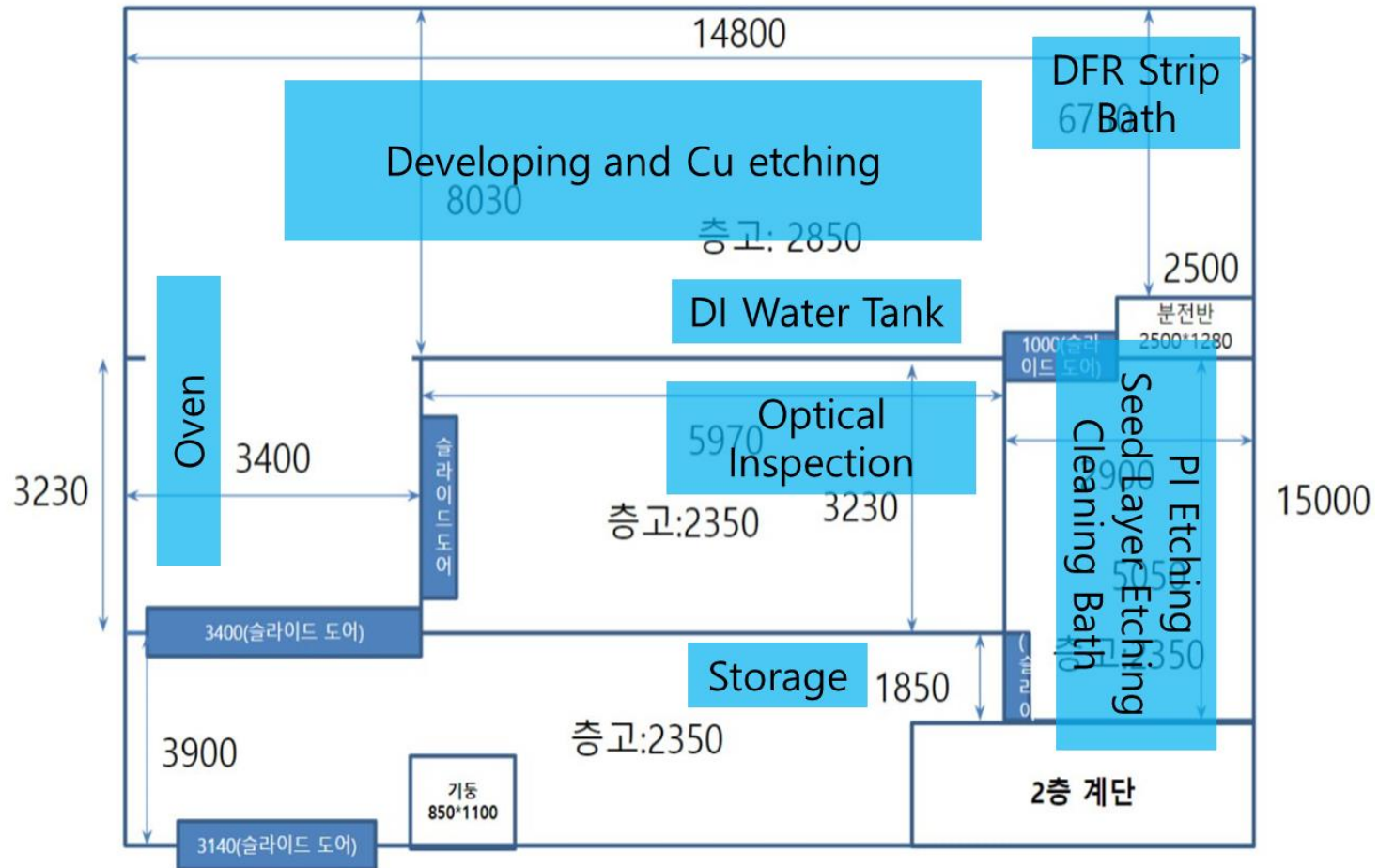
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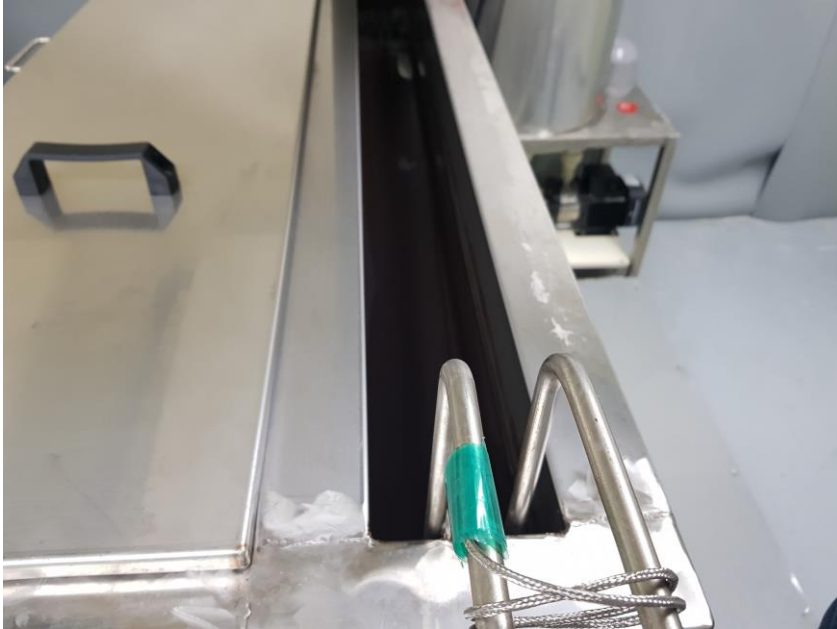
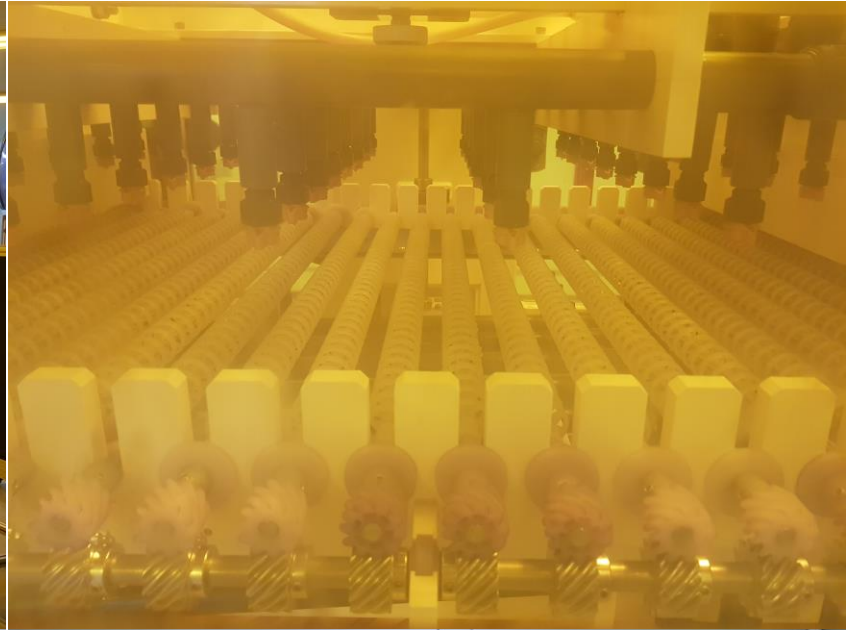


3. Facilities – Chemical site

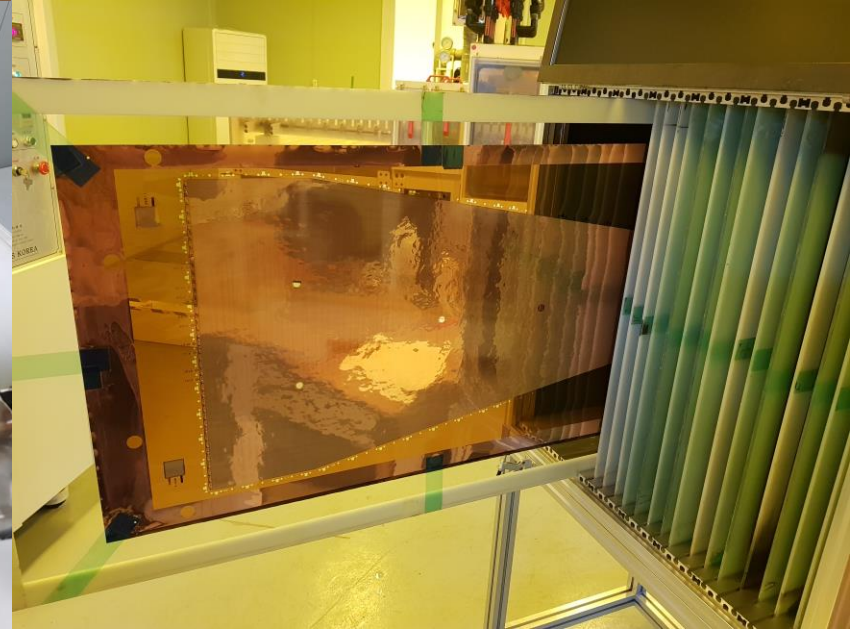


- Making via, soldering SMD, packaging ETC are done in 2nd floor

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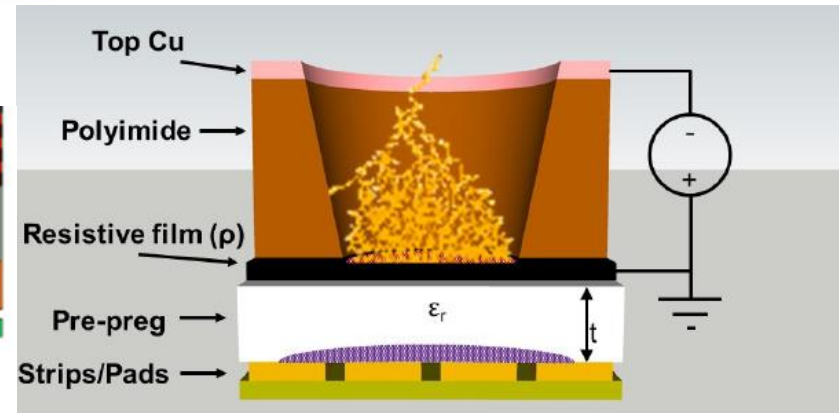
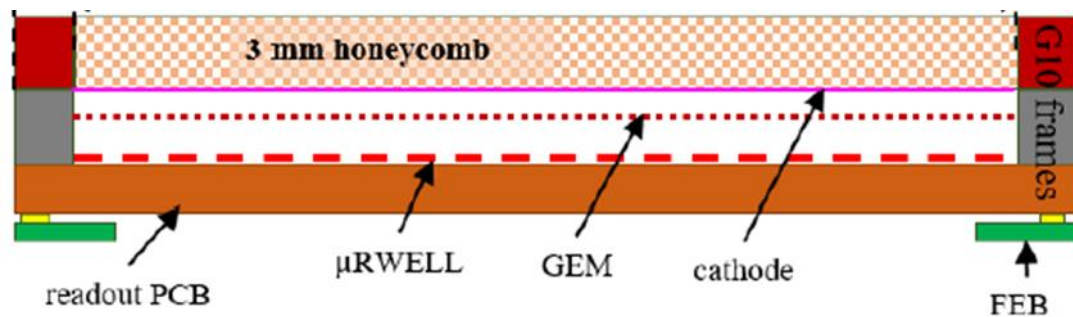
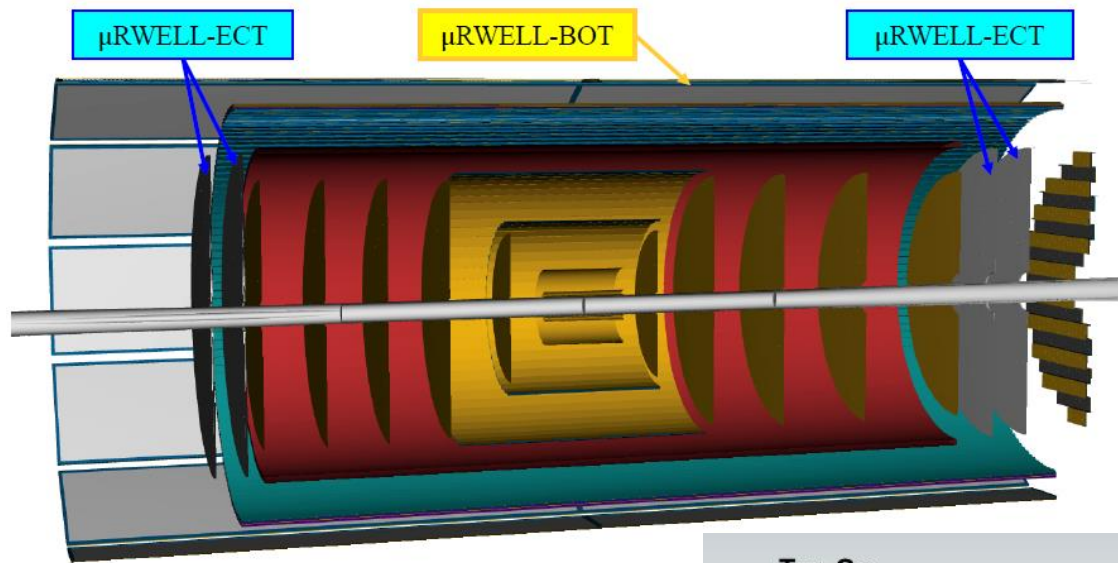


4. Current status of the production site

- Mass production of CMS ME0 just starts
 - 666 foils
- The production will be ended by Q4 of 2025 (strict deadline due to LHC schedule)
 - and after that? ePIC!

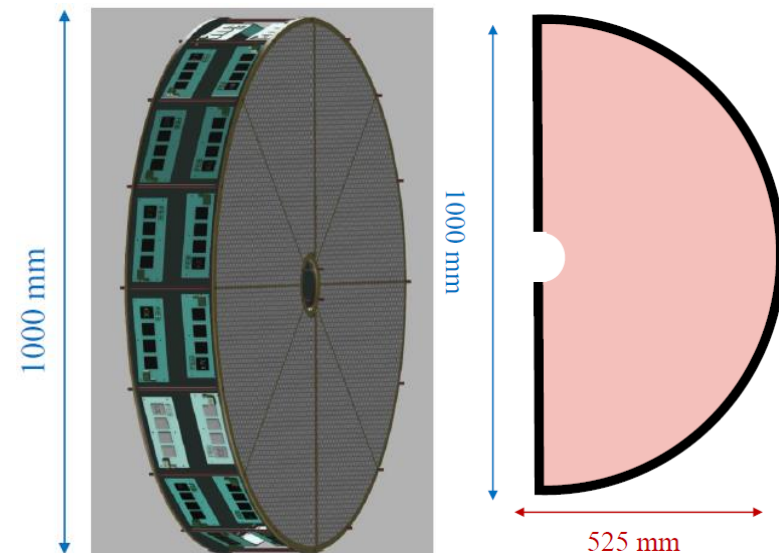
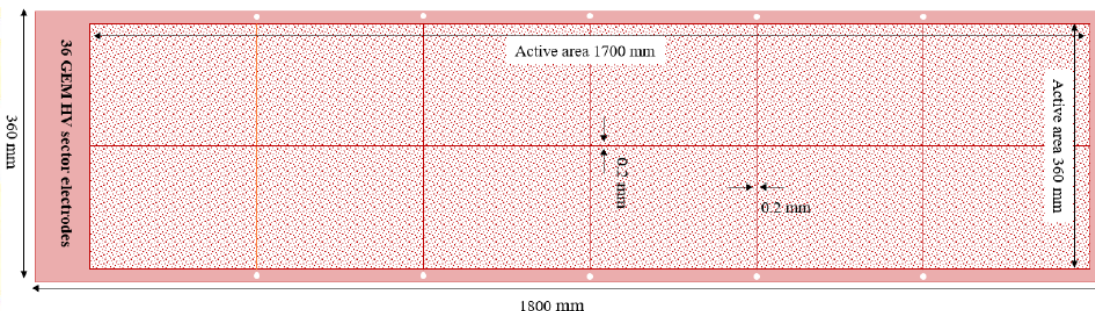
5. Contribution plan toward ePIC

- Korean MPGD group is willing to produce GEM & μ RWELL for μ RWELL ECT
 - Hopely, production site as well



5. Contribution plan toward ePIC

- Korean MPGD group is willing to produce GEM & μ RWELL for μ RWELL ECT
 - $2 \times 2 \times 2 + \text{spare} = 10 - 12$ GEM and μ RWELL PCB
 - This number can increase in case end cap MAPS tracker is delayed. In this case the MPGD tracker temporarily takes over the roles
 - **The process to secure the budget is underway. It looks hopeful**
- Unfortunately, μ RWELL BOT is too large
 - $170 \times 36 \text{ cm}^2$. Capability $120 \times 58 \text{ cm}^2$
- Producing GEM is not a big deal
 - Once gerber file is frozen, we will produce mask and GEM for prototyping

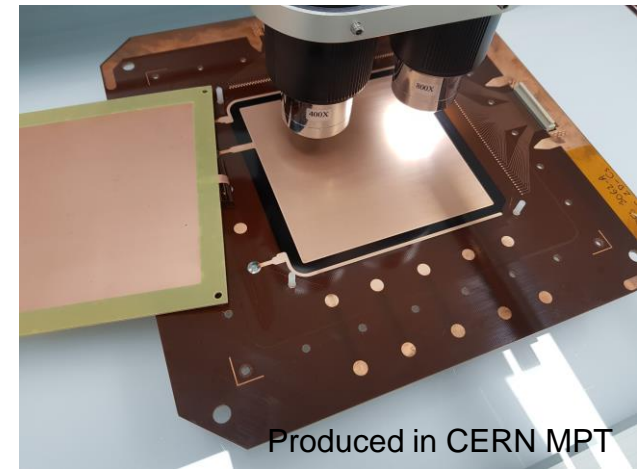


6. μ RWELL R&D plan

- Producing μ RWELL needs R&D
 - In principle, we have the necessary equipment and Tech. to produce μ RWELL
- Production strategy
 - DLC-FCCL will be purchased
 - Planning to purchase readout PCB, to outsource the DLC-FCCL pressing process to a contractor and to do the latter processes such as GEM patterning process by ourselves
 - Rui helps us a lot. I and technician of the Korean GEM group will visit CERN MPT for technology transfer around Apr.
 - PnF Co., a PCB production company, helps us as well

6. μ RWELL R&D plan

- We will attempt to produce $10 \times 10\text{cm}^2$ μ RWELL within a year
 - From experience in GEM production, if we can make the small μ RWELL, scaling up would not be difficult
 - So, we will get good guess of the feasibility within a year
 - Seeding budget is secured
- μ RWELL is charming and natural extension for us
 - We will be doing this R&D not only for ePIC, but also for the DAMSA experiment, and ultimately for FCC-ee
 - This R&D plan is supported by Korean HEP community as well



Summary

- For CMS Phase-2 GEM upgrade, KCMS is producing large-sized GEM foils
 - Fully qualified through CMS GE1/1 and GE2/1 projects
- After the consortium with Mecaro over, facilities have been relocated
 - Photo processes: IBS
 - Chemical processes: PCB making site
 - Green light has been obtained and mass production is ongoing
- We are willing to expand our expertise to μ RWELL and contribute to ePIC μ RWELL ECT
 - To check the feasibility, we will production of $10 \times 10 \text{ cm}^2$ μ RWELL within a year
- The process to secure the budget is underway
 - It looks hopeful