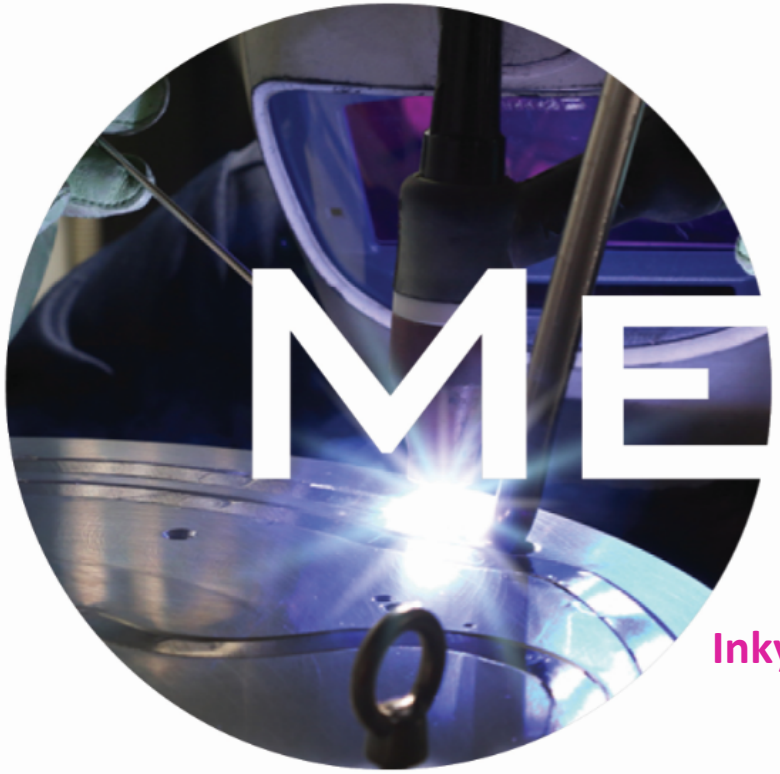
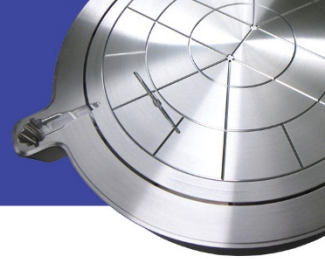
Mass Production of GEM foils in Korea



July 6, 2018 @ ICHEP 2018, Seoul
Inkyu Park (University of Seoul) on behalf of MECARO

MECARO
㈜메카로

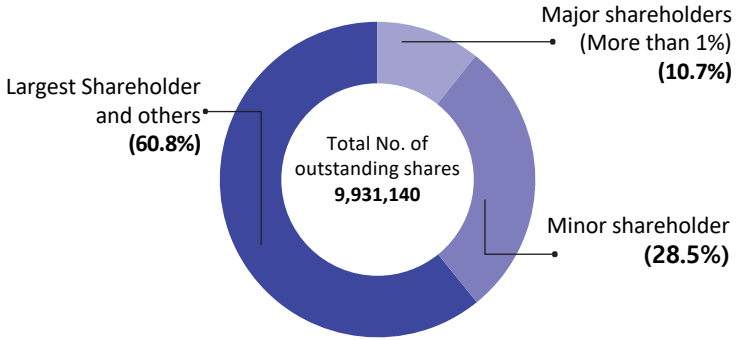
About MECARO



Company Overview

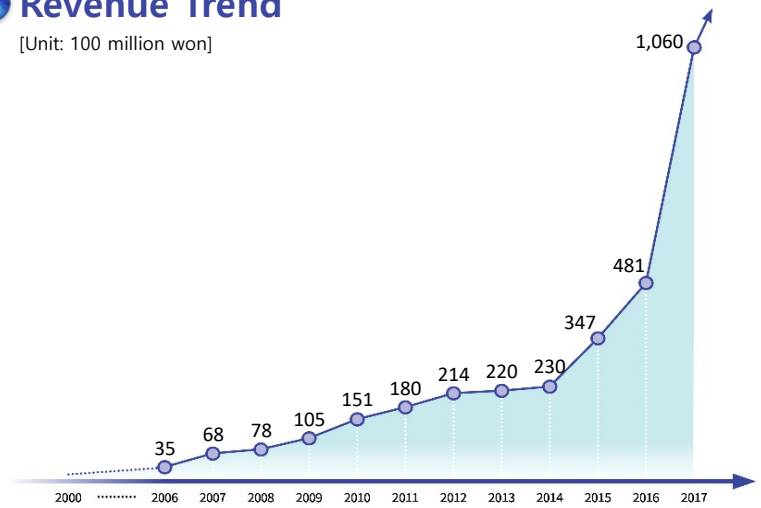
Company name	Mecaro Co., Ltd.
CEO	Lee, Jae Jeong
Date of establishment	November 2000
Capital	USD 4.61M(4.97 Billion Won)
Business area	Development, manufacture and sales of semiconductor equipment related parts and chemicals
Main product	Precursor and heater block for semiconductor
No. of employees	220 (as of December 31, 2017)
Location	Head office: 103-14, Sandan-ro, Pyeongtaek-si, Gyeonggi-do, Republic of Korea (Songtan Industrial complex, Mogok-dong 439-5)
	2nd business location: 261, Wonnamsandan-ro, Wonnam-myeon, Eumseong-gun, Chungcheongbuk-do, Republic of Korea (717 Wonnam Industrial Complext, Sangdang-ri)
	3rd business location: 26-1, Daeyang-ro, Mokpo-si, Jeollanam-do, Republic of Korea (Ceramic center Production support building 105-1, Yeonsan-dong)
Homepage	www.mecaro.com

Shareholders (as of December 31 2017)



Revenue Trend

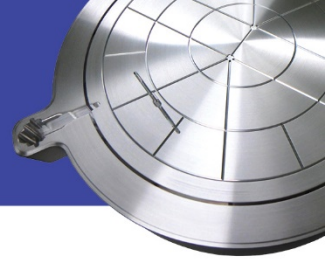
[Unit: 100 million won]



Location

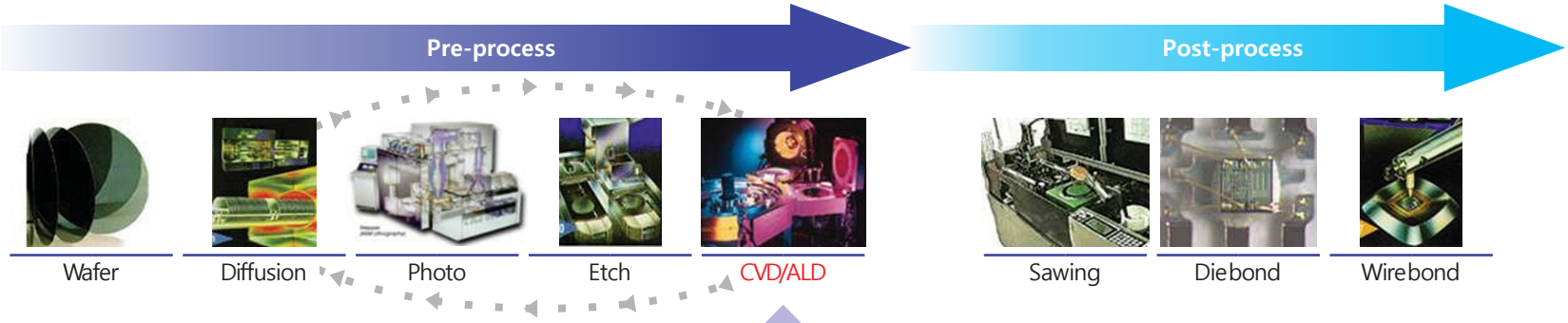
Wonnam technopark, Korea

Main products summary



» **Precursor - chemicals used in thin film deposition in semiconductor manufacturing processes**

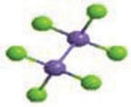
» **Heater block - a functional part that uniformly supplies thermal energy to a silicon wafer**

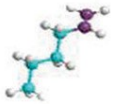


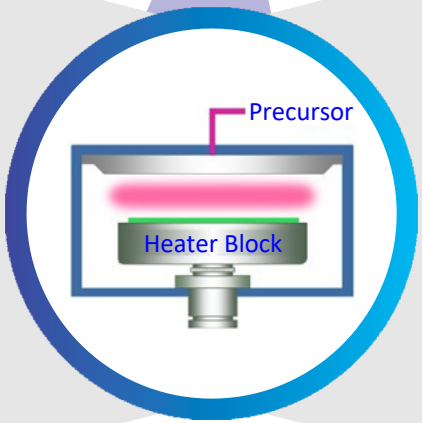
Precursor


Cap. Dielectric film (Cp-Zr/ZM40)


Cap. Electrode (TiCl4)


Low temperature Oxide (HCDS)


α-Carbon (1-Hexene)



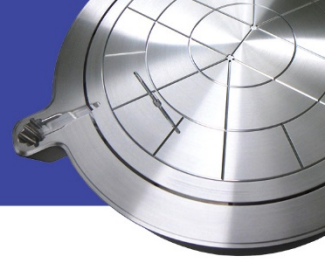
Heater Block


Heater Block


Susceptor


Shower Head

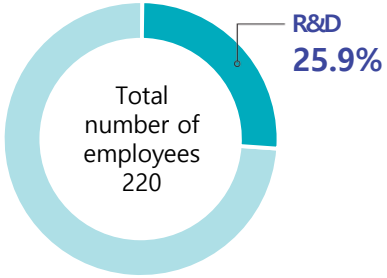
R&D oriented

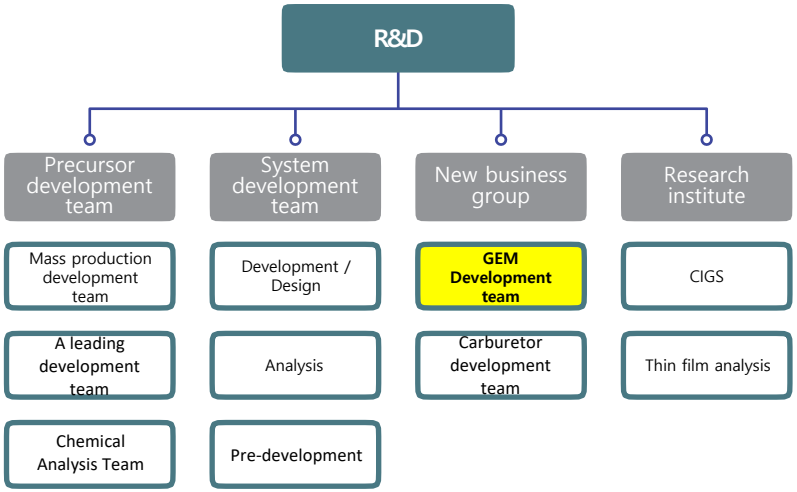


» **Industry-leading R&D infrastructure and systematic structure**

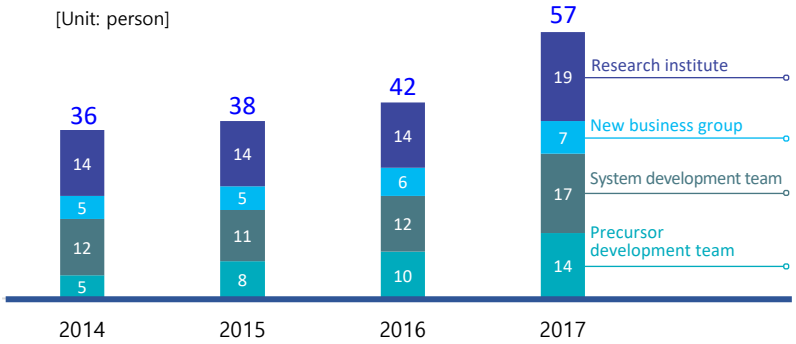
» **Securing high technological capability through continuous R&D investment**

R&D personnel and organization status





Development of R&D personnel

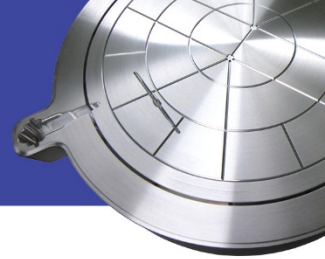


Major intellectual property rights

(patent rights: 22 cases, pending: 6 cases)

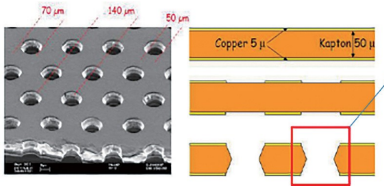
Classification	Content	Registration date
Precursor	New organo-metallic compound containing zirconium metal and manufacturing method	2013.05.06
Heater Block	Chemical vapor deposition pedestal heater block	2009.12.29
Solar cell	CIGS thin film manufacturing method	2011.10.04
New business	Vaporizer for substrate processing equipment	2016.02.01

Explore new engines



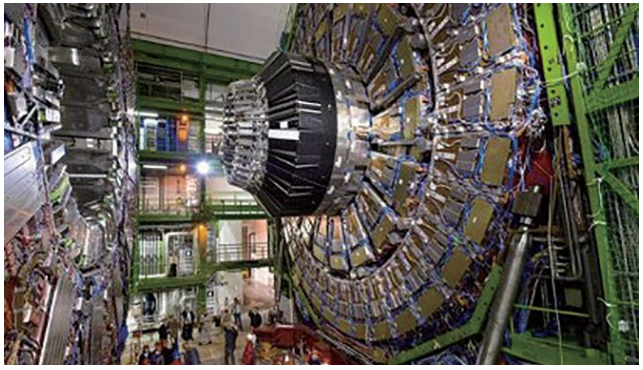
» Expand to adjacent high value-added business utilizing core technology capability

GEM technology

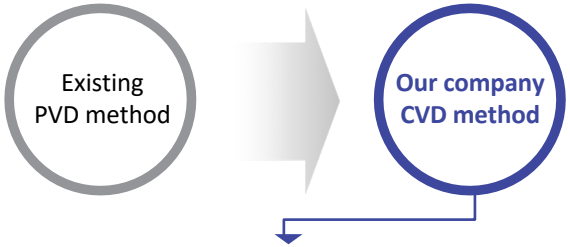


The principle of generating an electron avalanche by forming an electric field inside a small spherical fine hole

- State-of-the-art semiconductor technology application for processing hundreds of thousands of long spherical fine holes in a single piece of GEM foil (500x1000mm) for detecting particles with high precision.
- Secured price competitiveness by simplifying the production process, that allows mass-production of GEM



CIGS thin film solar cell

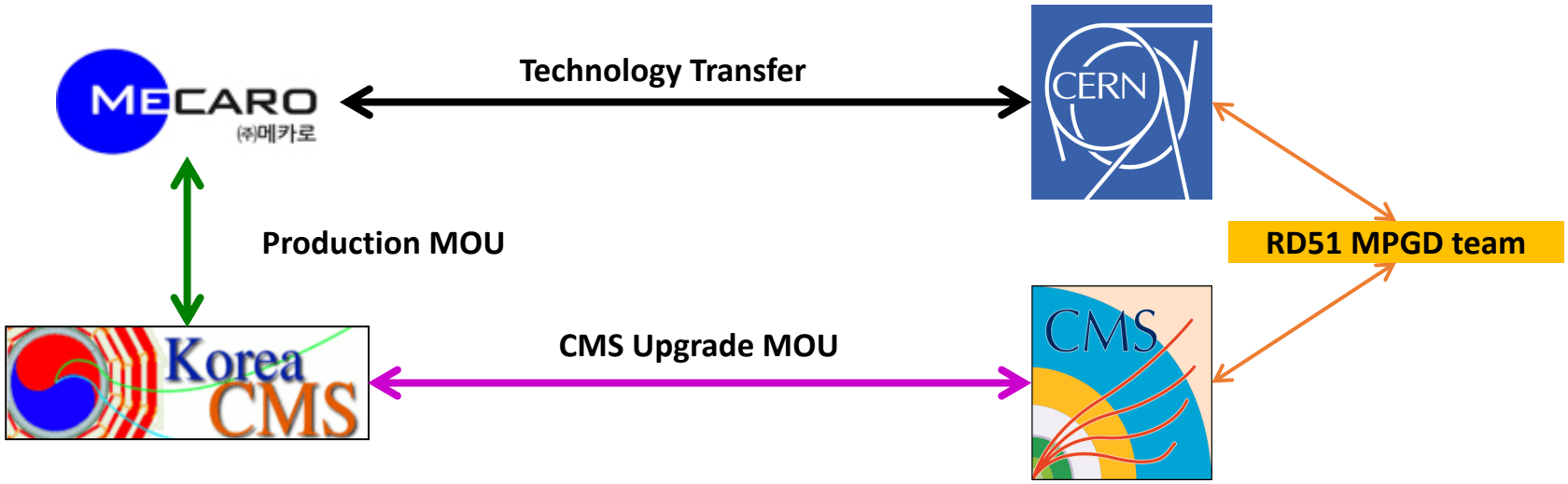


- Compared to existing PVD method, it consumes fewer raw materials and is easy to enlarge
- System construction cost is only 1/3 to 1/5 of PVD
- Suitable for mass production of flexible CIGS due to development of relative low-temperature process technology
- The result of our precursor synthesis technology and heater block manufacturing technology

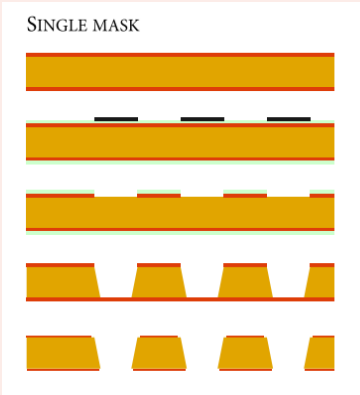
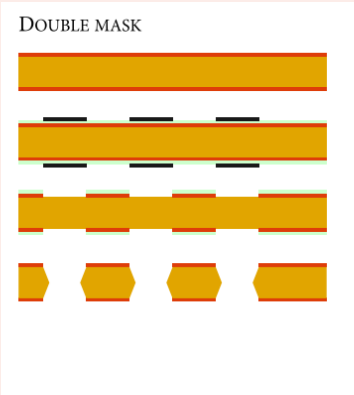
GEM Partnership Structure

Mecaro produces GEM Foil to Korea CMS.

Korea CMS is participating to upgrade Muon system of CMS during LS2 and LS3 period.

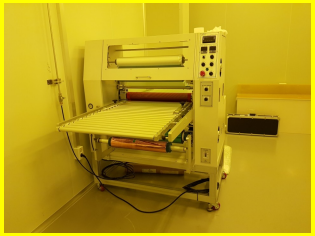


GEM production method

	Single-mask	Double mask
Infrastructure	Cheap	Expensive
Mask alignment	No need (film)	Crucial (Glass only)
Pros & Cons in size	Large size capable	Limited in size
Production method		
Production process	Complicate	Simple
Production time	Long	Fast
Labor cost	Expensive	Cheap

Production chain

DFR Film laminator



Large Bipolar Exposure

DFR Film Developer

Cu layer etcher

Cleaner & Dryer

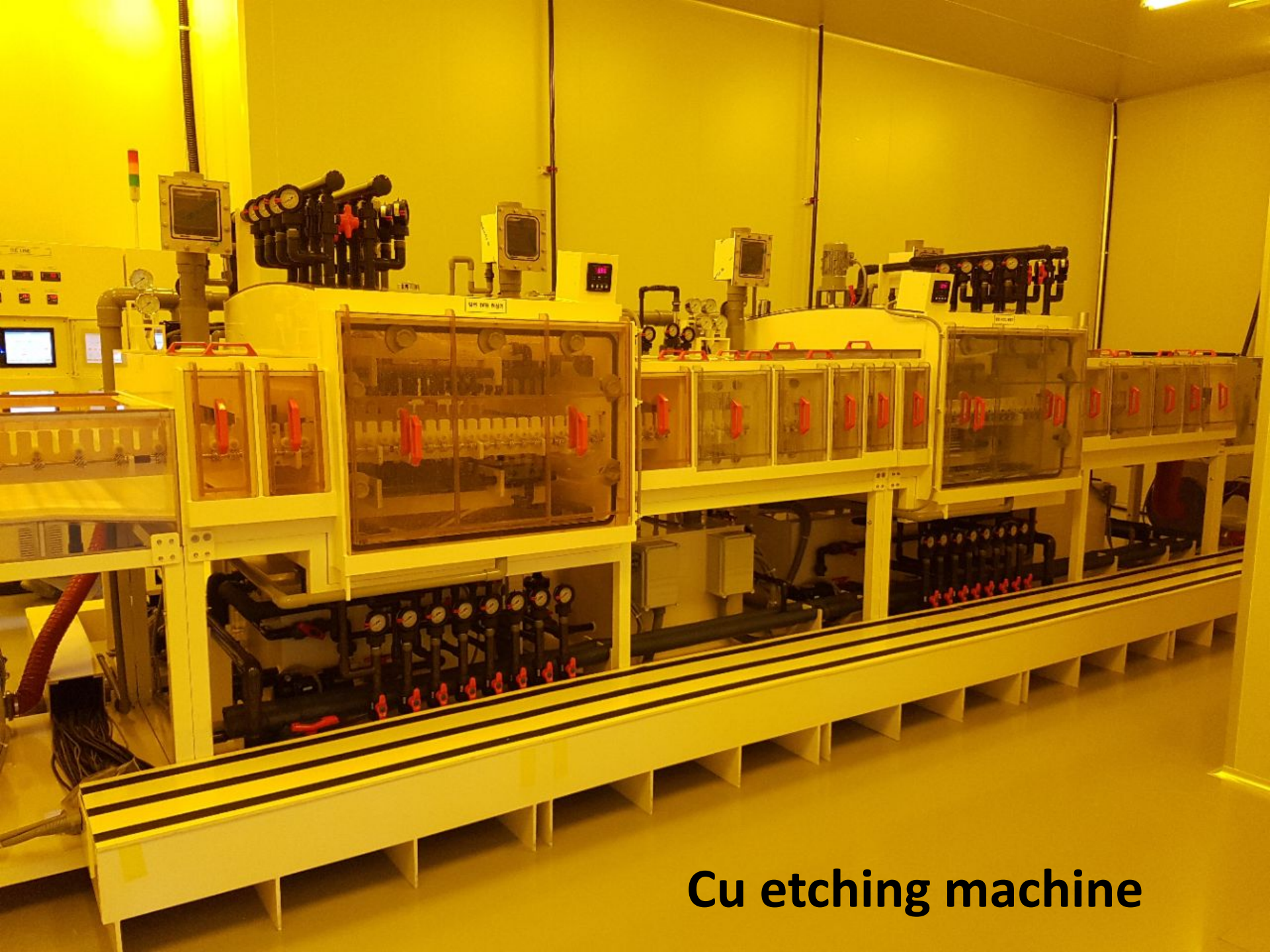
PI etching machine

Cleaner & Dryer

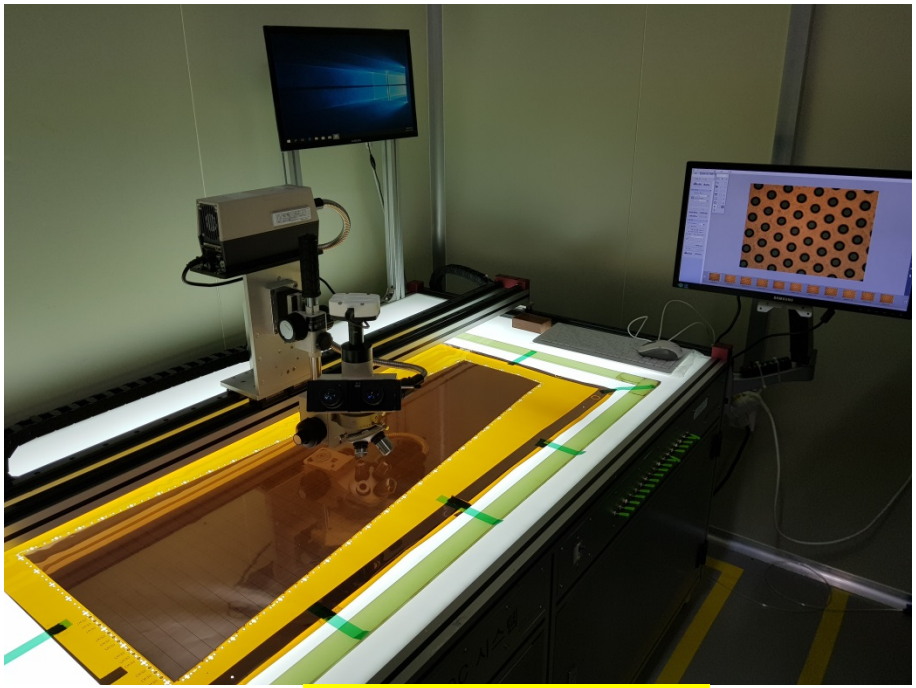
Inspection & QC

All facilities completed in 2013~2017

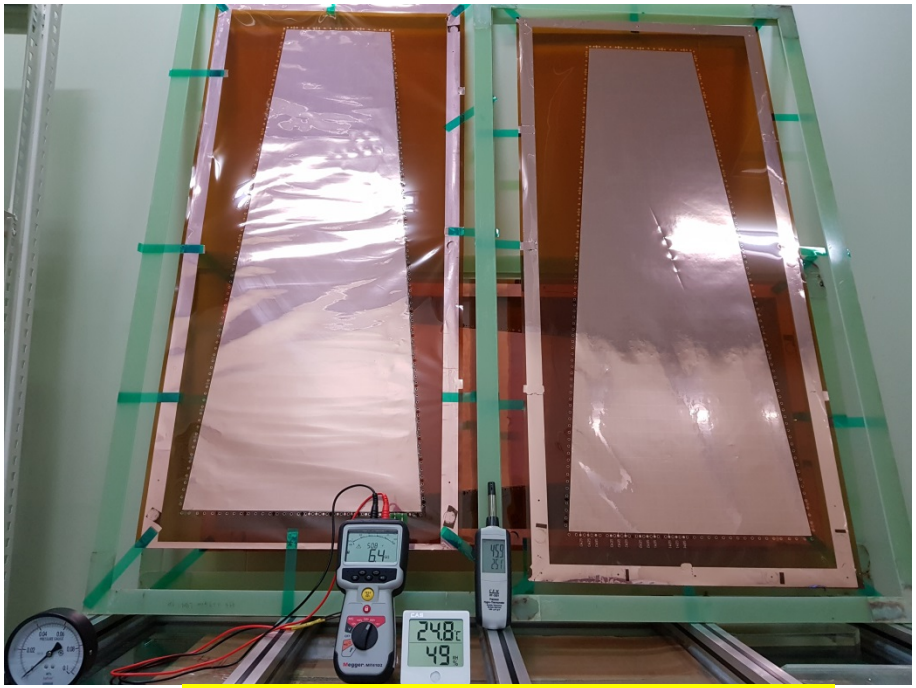
Large Bipolar Exposure


Cu etching machine

Quality control



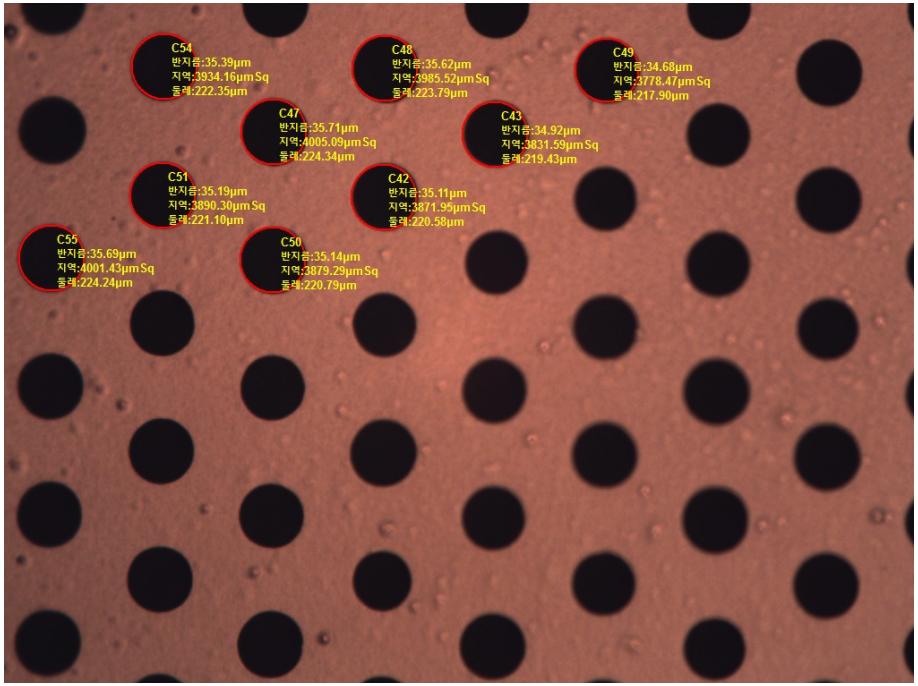
Optical Inspection

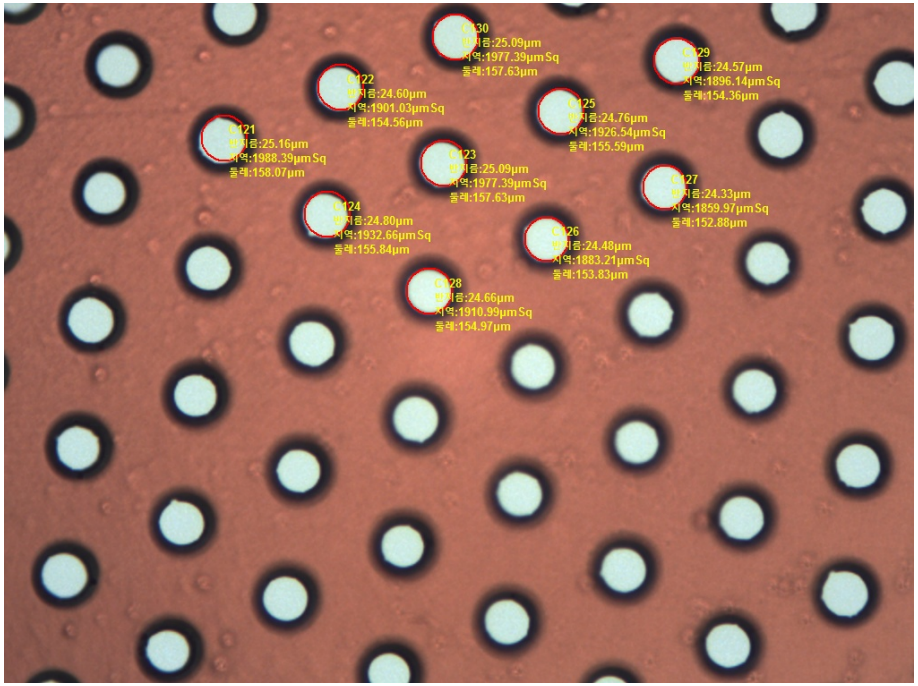


Leakage current measurement

QC Long (24-hour leakage current measurement) assured before packaging and shipment.

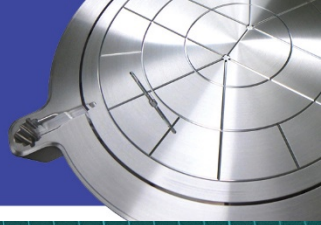
GEM hole quality



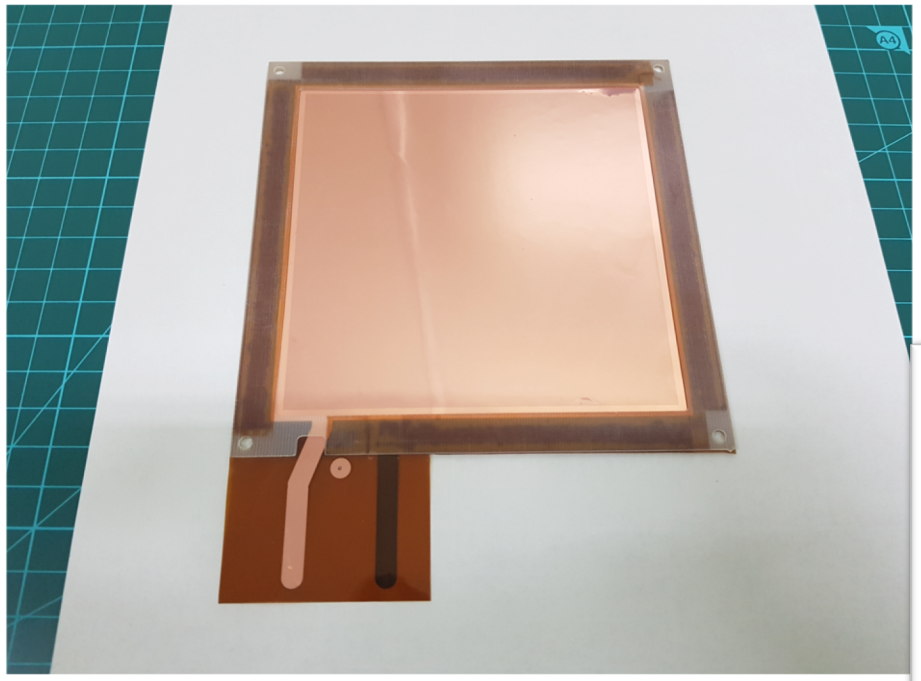


- **Outer hole sizes are 68 ~ 72 um. (design goal = 70um)**
- **Inner hole size are 48 ~ 52 um. (design goal = 50 um)**

An example of GEM product



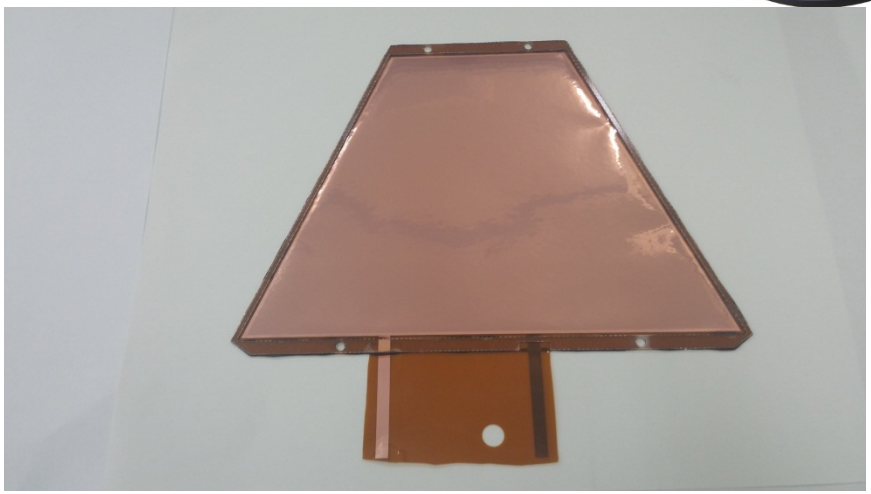
Readiness for order



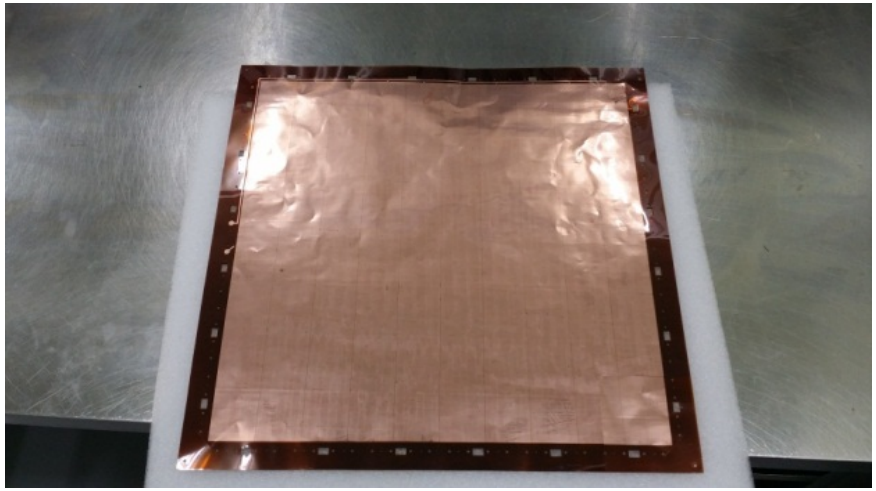
Stacking 5 GEMs

Packing for a set of 5 GEMs

Various GEM products

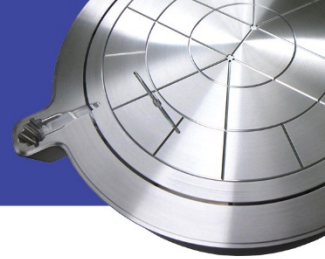


135 x 175 mm^2



300x300 mm^2

Summary: GEM Foil Roadmap



2013Y

✓**Technical License agreement with CERN**

2014Y – 2017Y

Developed with double side photolithography method

✓**5x5cm/10x10cm/30x30cm** : Developed in 2014

→ 10x10cm : Developed and completed Quality Test with **CERN CMS** in 2014

High gain & good uniformity obtained

✓Provide GEMs to Institute for Basic Science(IBS) and some universities in 2016

✓**CMS GE1/1(Large Size)** : Started to develop in 2016 and delievered in 2017

Successful Quality Test by **CERN CMS** in 2017

2018Y – 2023Y

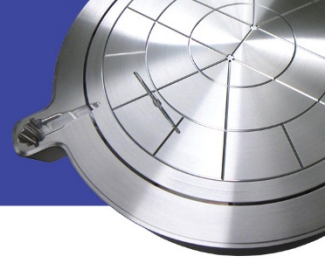
✓**Developping application products of GEM detector in 2018**

✓**35x43cm** : Produced to Institute for Basic Science in 2018

✓**CMS GE2/1** : Schedule to produce **456** Foils to **CERN CMS** from 2018 to 2021

✓**CMS ME0** : Schedule to produce **666** Foils to **CERN CMS** from 2021 to 2023

Future Plan for GEM



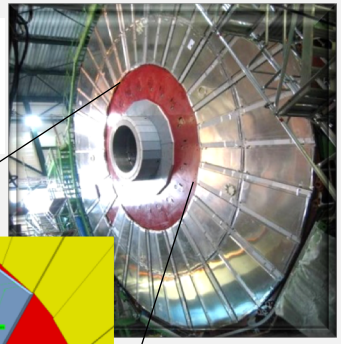
» Our aim is to innovate to bring GEM's new technology to people with our all capabilities, which significantly improves people's life.

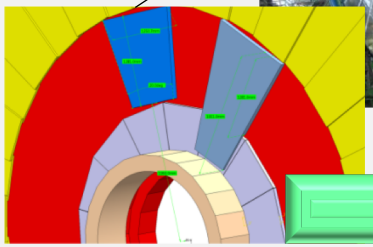
GEM Foil Development(2019~2021Y)

GEM Foil : Provide to CERN

GE21 / ME0

About 1100 EA

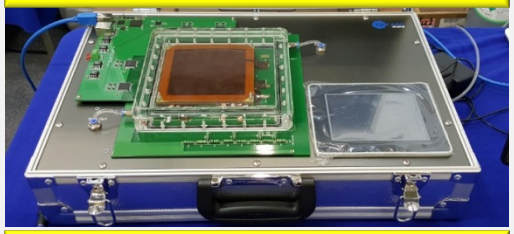




CERN

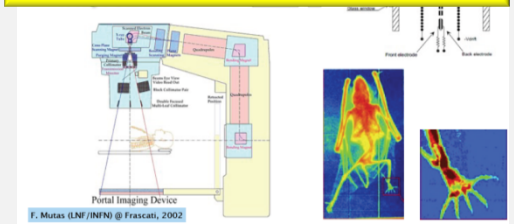
Applied products development(2018~2025Y)

Detector for Physics Experiment

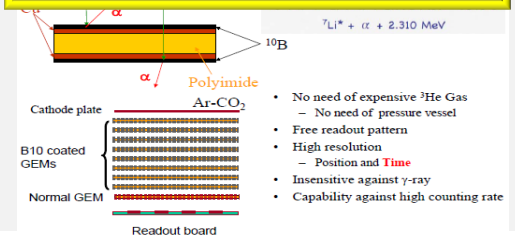


Radioactive Waste Detector

Medical Radiation Imaging



GEM Neutron Detector

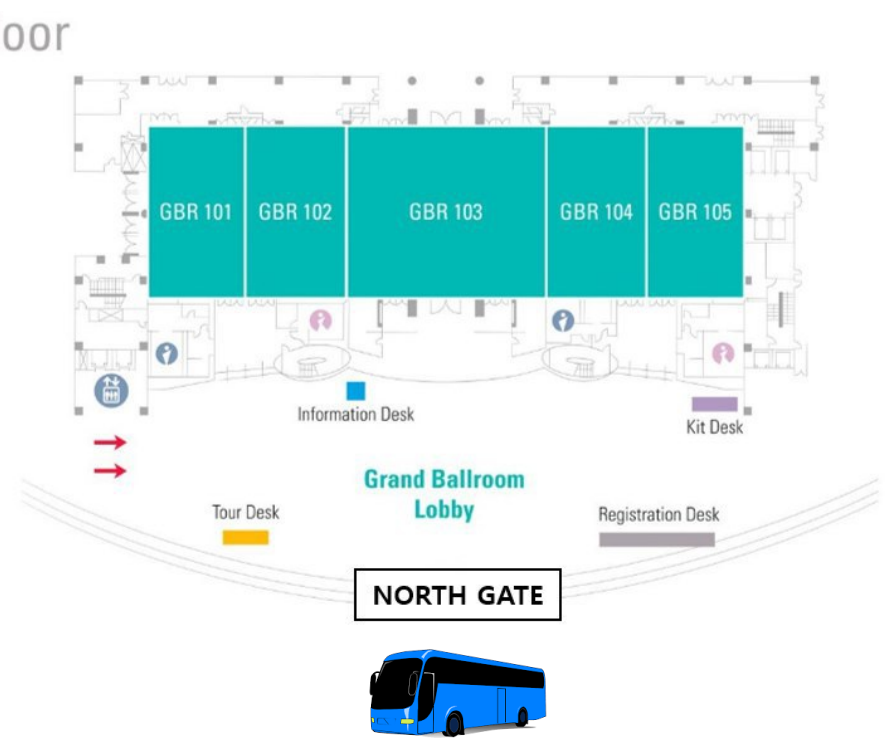


Visit the MECARO exposition booth in ICHEP2018 July 5-7 (COEX)

MECARO visit on July 7 (Sat)

The bus will leave at 9:00 am sharp in front of the main gate of ICHEP site.

09:00 - 10:30: Move to MECARO (expected transportation time is about 100min)
10:30 - 11:00: Reception
11:00 - 12:00: Visit to the MECARO GEM production site
12:00 - 12:30: CMS-KCMS-MECARO meeting and Q&A
12:30 - 14:00: Lunch
14:00 - 15:30: Return to ICHEP.



Thank you!

Head office

103-14, Sandan-ro, Pyeongtaek-si, Gyeonggi-do, Republic of Korea | **Tel** (031) 646-4400 | **Fax** (031) 663-4479

Eumseong office

261, Wonnamsandan-ro, Eumseong-gun, Chungcheongbuk-do, Republic of Korea | **Tel** (070) 4613-2700 | **Fax** (070) 8250-8232

Mokpo office

26-1, Daeyang-ro, Mokpo-si, Jeollanam-do, Republic of Korea | **Tel** (061) 270-5093 | Fax (061) 278-7811