



서울시립대학교
UNIVERSITY OF SEOUL

RD51 membership application

Computational **P**hysics **L**ab.
@ **U**niversity **o**f **S**eoul

Oct. 22, 2019

Inkyu Park on behalf of CPLUOS

Our team introduction CPLUOS

Location

Science & Tech building



Computational Physics Lab. @ University of Seoul



Lab. organization (3 teams)

Particle Physics (CMS) team

- Top Physics
- SM Precision measurement
- CMSSW Software development

Computing & Detector team

- CMS Muon upgrade
- Trigger SW, Detector simulation
- GEM foil production
- GEM application detector R&D



CPL
UOS

Theoretical/Astrophysics team

- Theoretical Particle Physics
- Cosmology, Astroparticle Physics
- Big data analysis

People (faculties & research associates)



Prof. Inkyu PARK

Particle Physics / Detector
CMS



Assoc. Prof. Jason LEE

Particle Physics / Detector
CMS



Dr. Ji Hyun KIM

Heavy Ion Physics, Top
CMS



Dr. Ian Watson

Particle Physics
CMS



Prof. Hyunsoo MIN

Theoretical Physics
Phenomenology



Prof. Dongsu BAK

Theoretical Physics
String / Cosmology



Dr. Sanghun LEE

Theoretical Physics
String / Field



Dr. Andreas GUSTAFSSON

Theoretical Physics
String / Field

People (Research ass., Engineers, Staffs)



Dr. Kyung Ju MA

Detector HW
CMS/NSRI



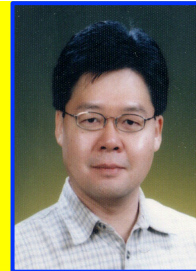
Dr. Sungwook HONG

Astrophysics
NSRI



Dr. Sangnam PARK

Astrophysics
NSRI



Seduk CHANG (Staff)

Sen. Secretariat / HW Eng.
NSRI



Sungho PARK (Eng)

Detector / Electronics
CMS



Haerim KANG (Staff)

Secretariat
NSRI



Young-gun JENG (Eng)

Detector/ Hardware
CMS



Namsu KIM (Tech)

Computer, Network, Web
CMS/NSRI

People (Grad. students)



Byunghak KO (Ph.D.)

GEM / Top physics
CMS



Dajung JEON (Ph.D.)

Top, $|V_{ts}|$ measurement
CMS



Donghyun SONG (Ph.D.)

GEM Detector
CMS



Sunyoung YOO (MS)

GEM Detector
CMS



Yechan KANG (Ph.D.)

GEANT4 Simulation / PP
CMS



Seung-Jin YANG (Ph.D.)

QCD Jets / GEM SW
CMS



Seulki KIM (Ph.D.)

Particle Physics / Astrophysics
CMS



Yun-Jae LEE (Ph.D.)

QCD Jets / GEM SW
CMS

People (Grad. students)



Jongsuk PARK (MS)

Particle Physics
CMS



Jua KIM (MS)

Double Higgs
CMS



Dayoung KANG (Ph.D.)

DQM SW / $Z' \rightarrow \tau\tau$
CMS



Woo-Jin JANG (Ph.D.)

$|V_{ts}|$ measurement
CMS



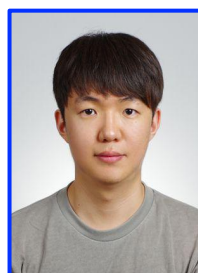
Yunkee KWON (MS)

Astrophysics
NSRI



Hannah JI (MS)

Astrophysics
NSRI

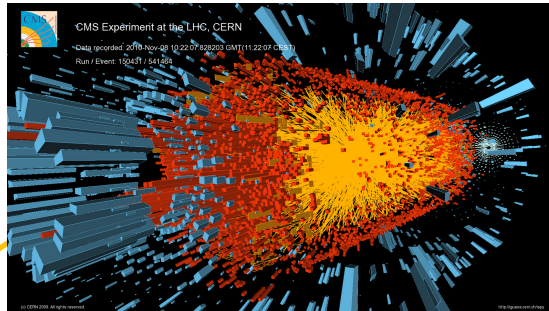


Hyeonmo KOO (MS)

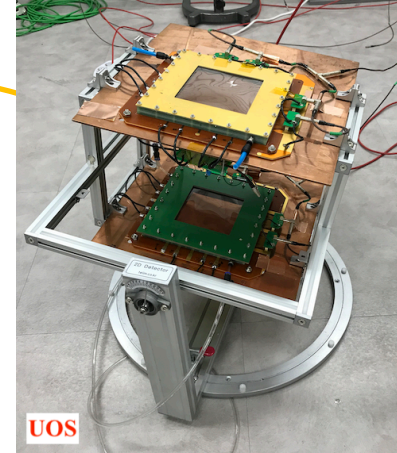
Astrophysics
NSRI

Current scientific activities

Particle Physics (CMS)

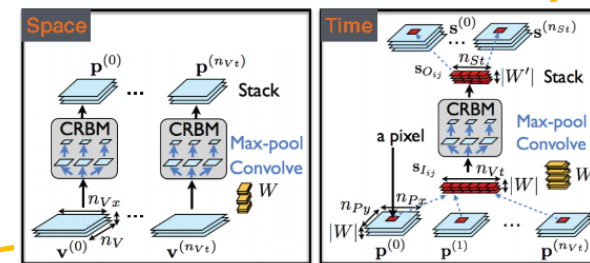
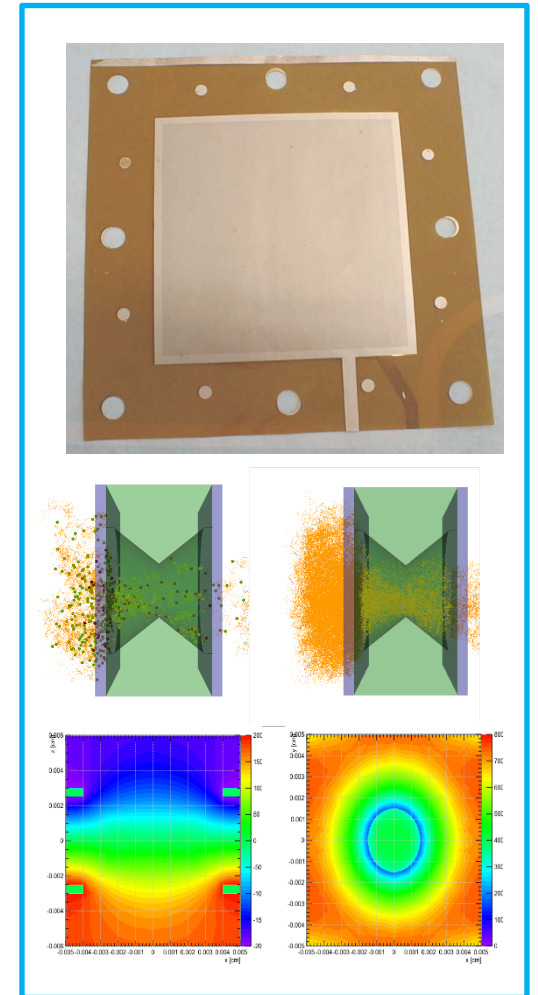
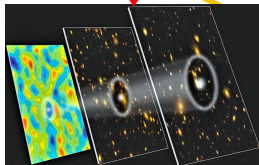
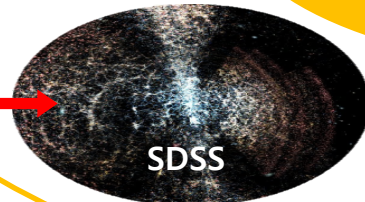
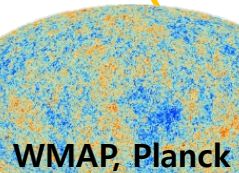


Particle detector R&D

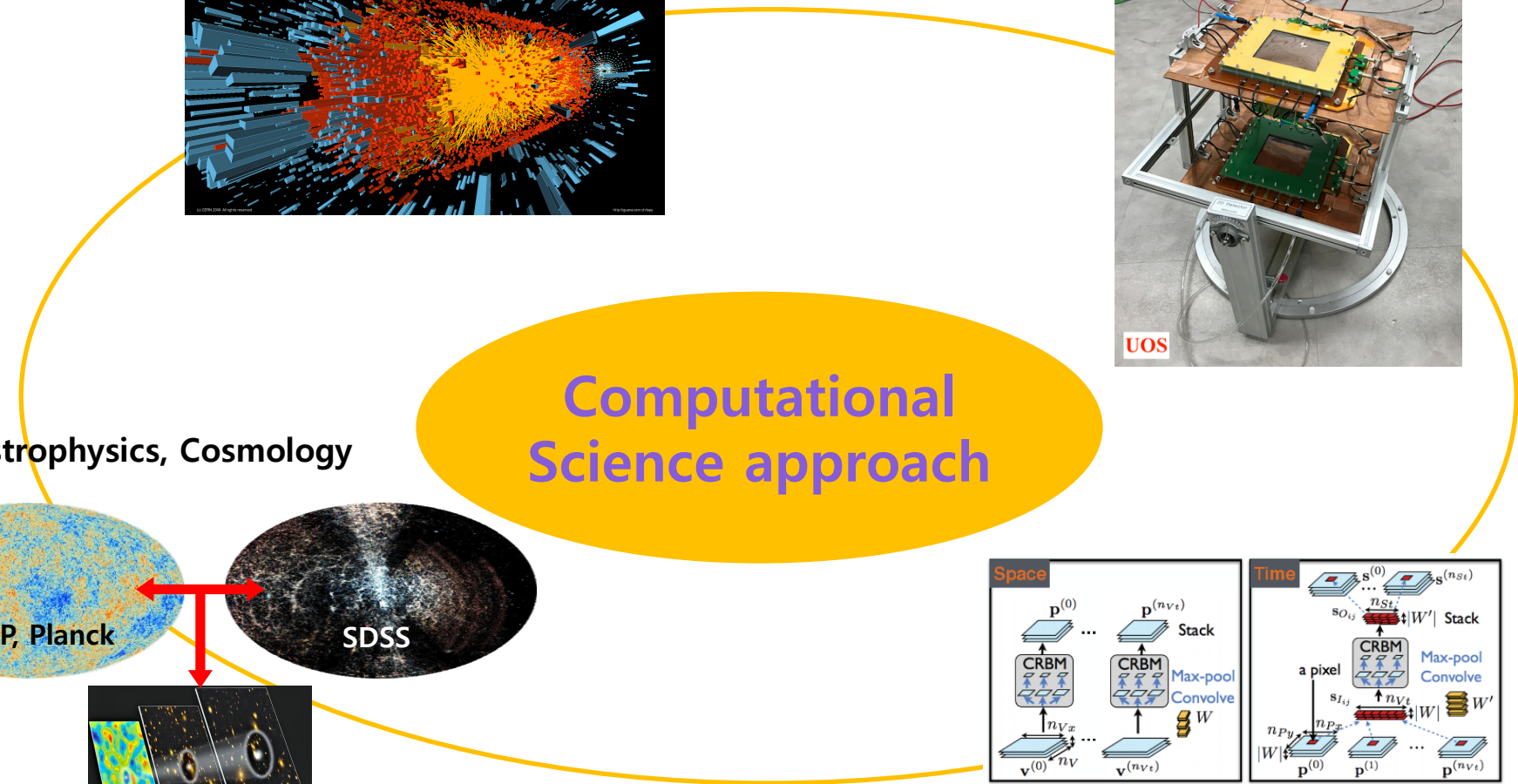


Computational
Science approach

Astrophysics, Cosmology

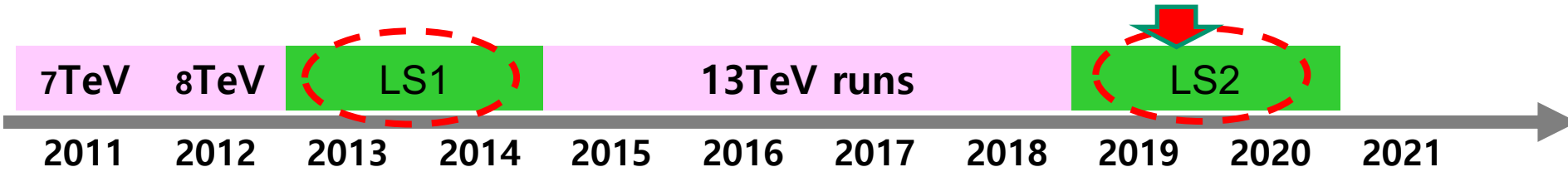


AI, Machine Learning, GPU



Large GEM foil production

Korea CMS muon upgrade participation

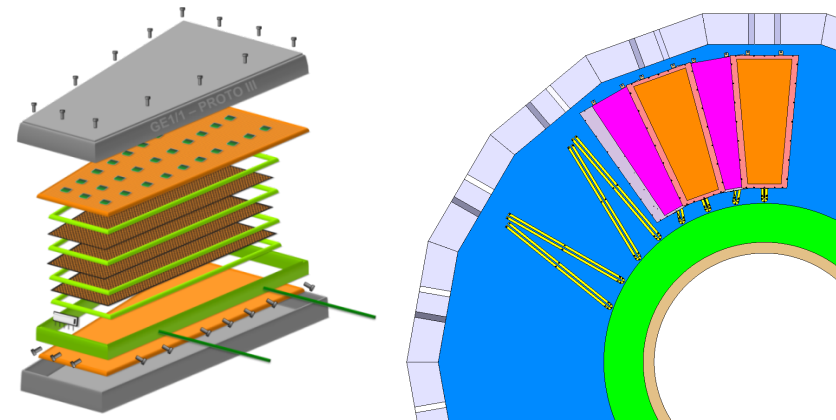


□ LS1 participation

- RPC Gap production
 - 660 gaps + 110 gaps
- RPC Chamber production
 - 10 chambers + many more

□ LS2/LS3 participation

- GEM foil production
 - GE11 (~100), GE21 (~500), ME0 (~500)
- GEM chamber production
- TDR & SW contributions

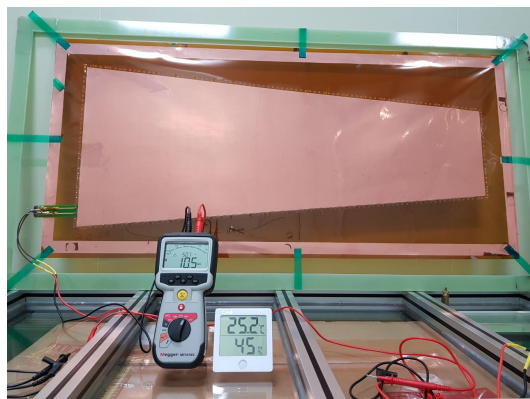
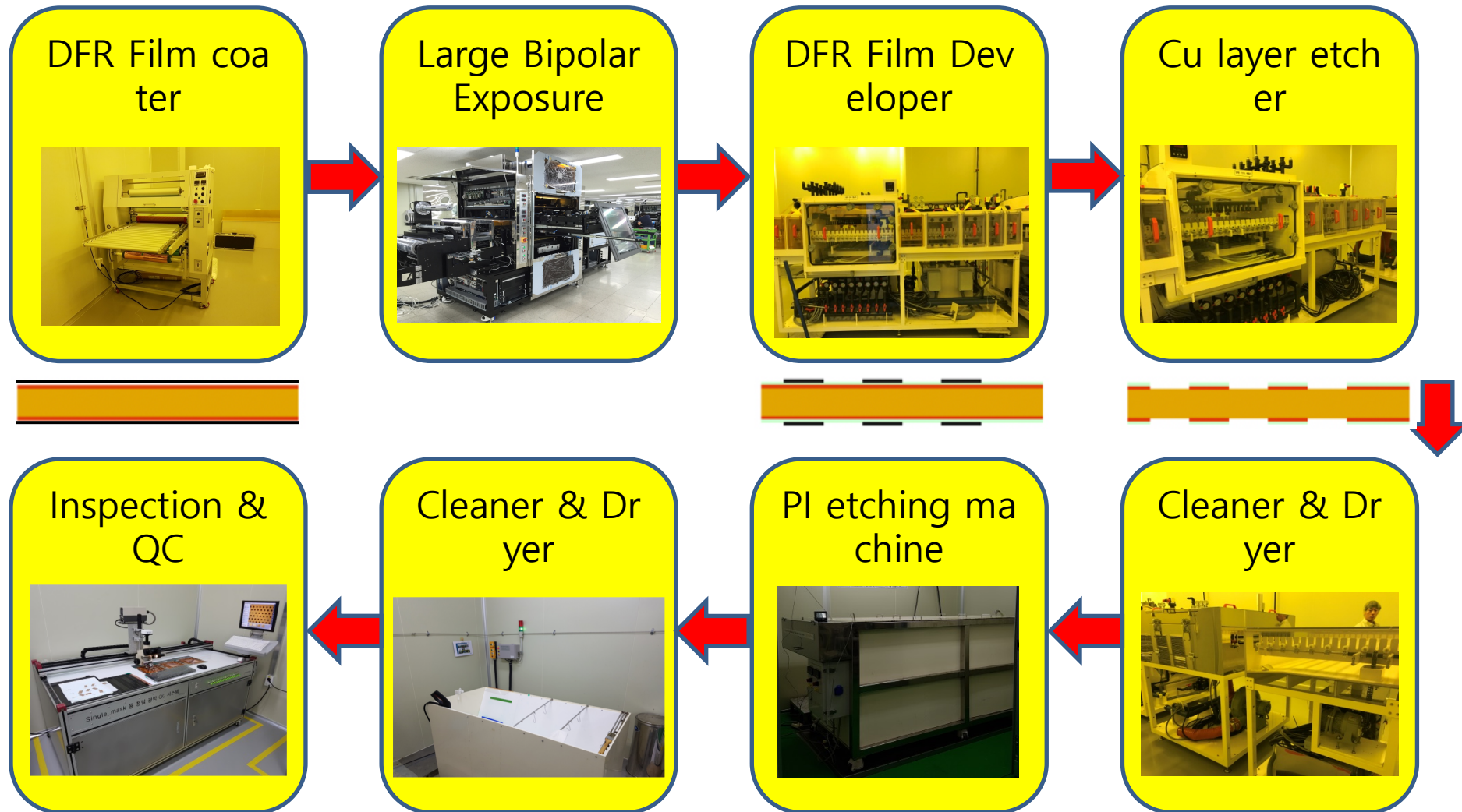


Production setup in MECARO



GEM production line at MECARO

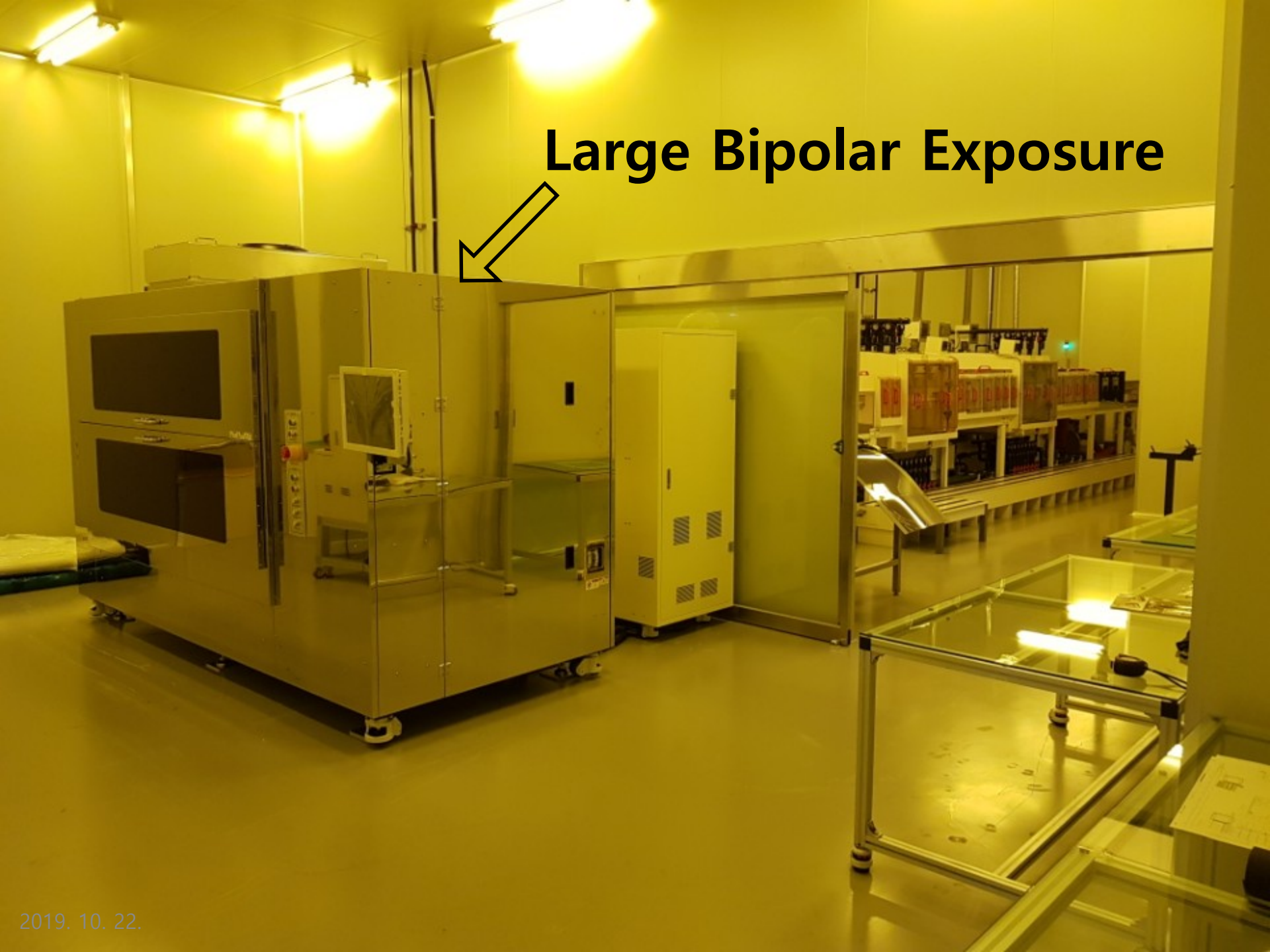
FCCL



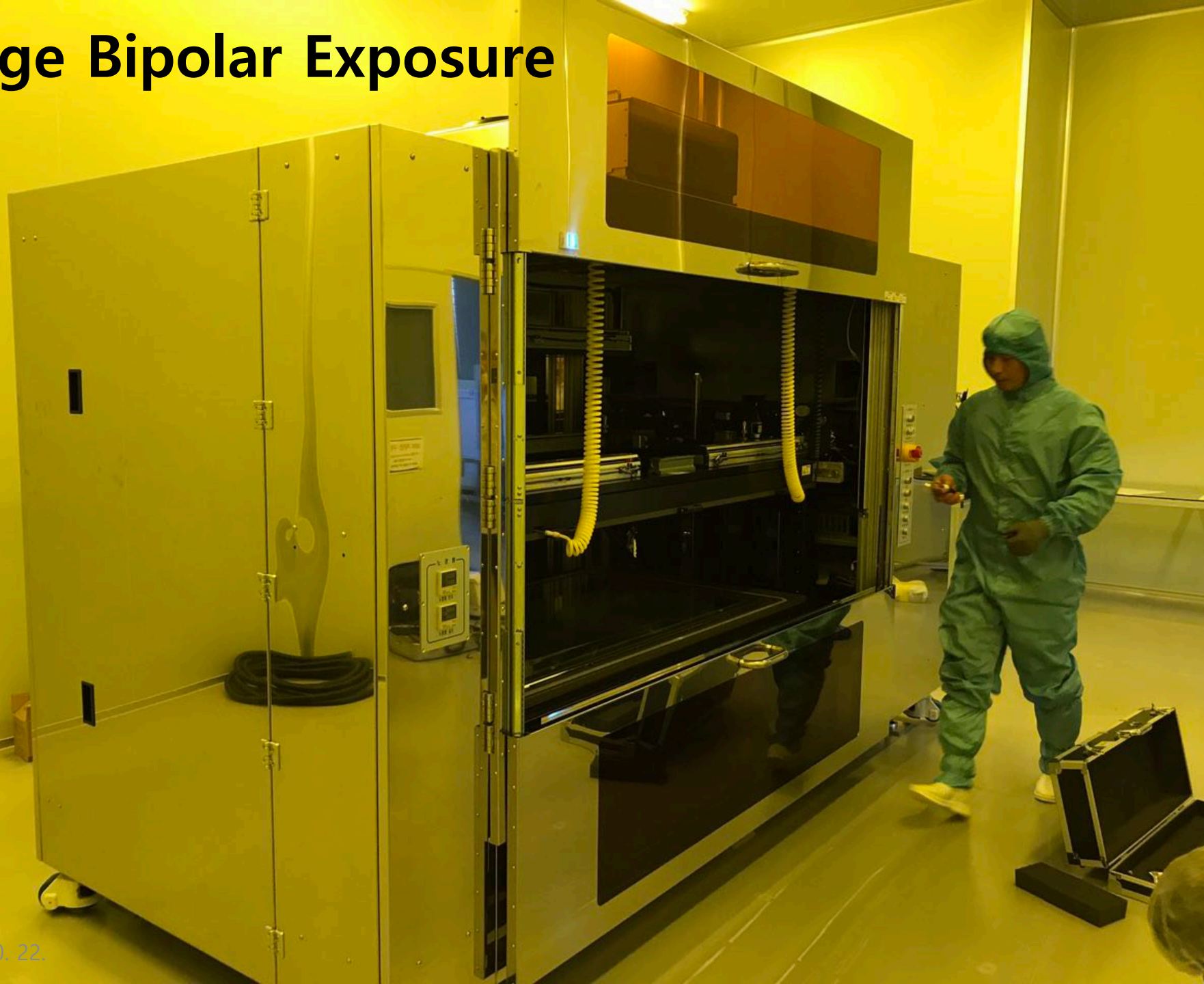
~ \$2M investment

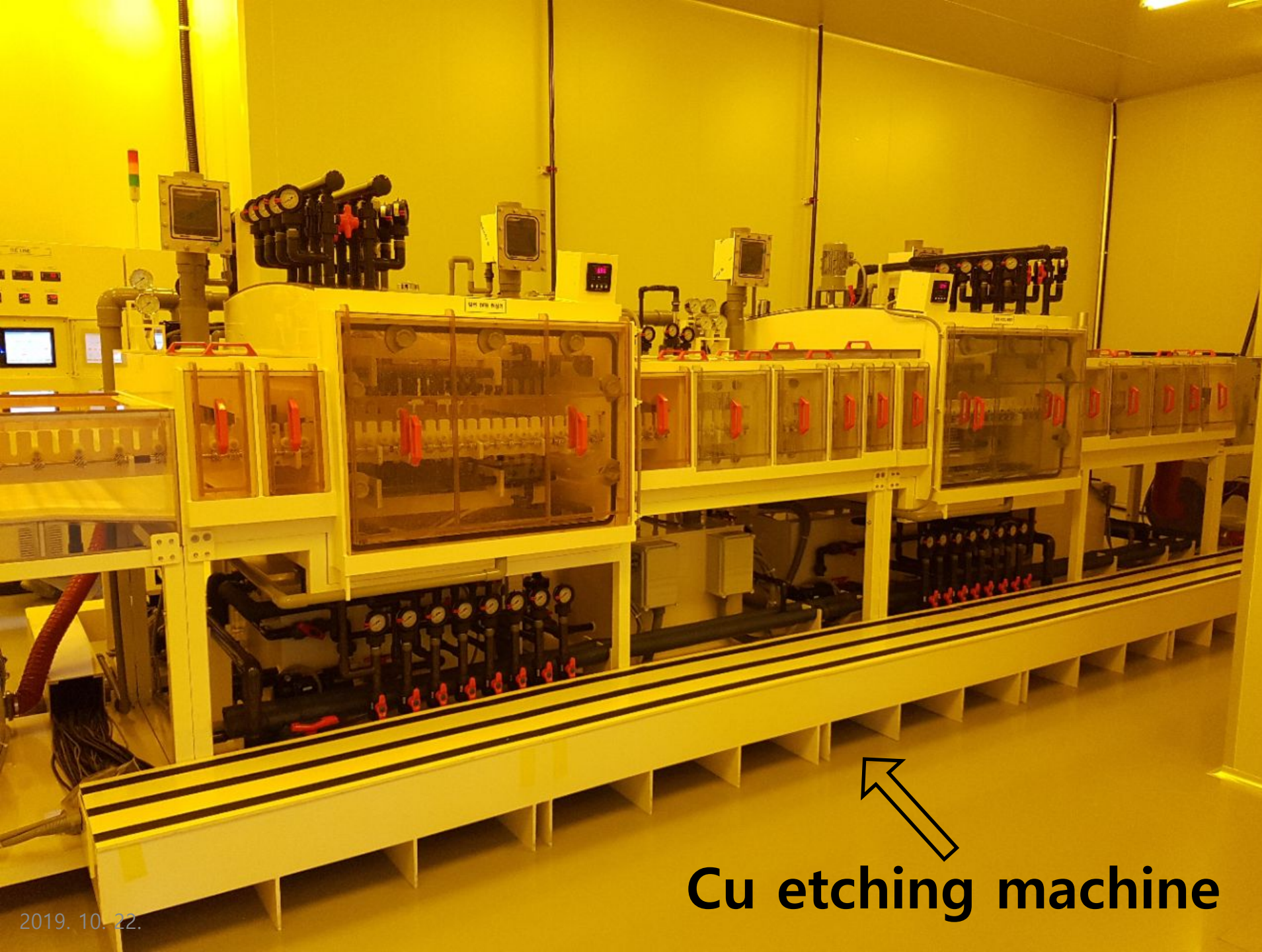


Large Bipolar Exposure



Large Bipolar Exposure

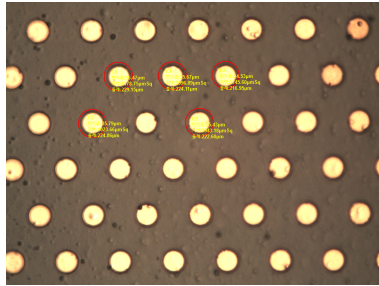




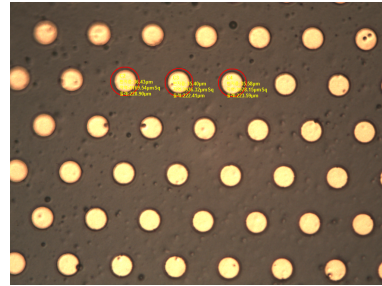
Cu etching machine

Large size GEM (Top view)

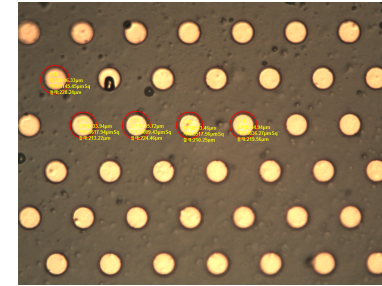
After DFR film development



left

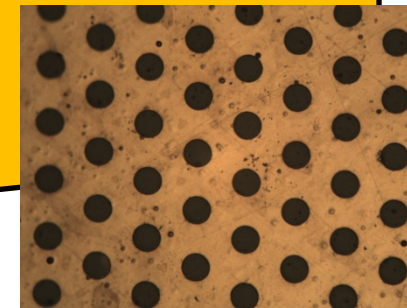
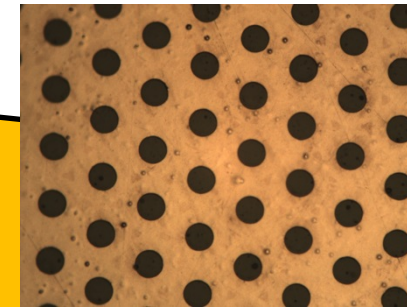
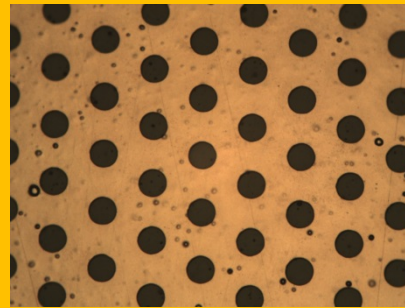
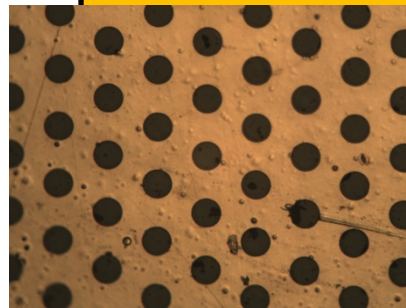
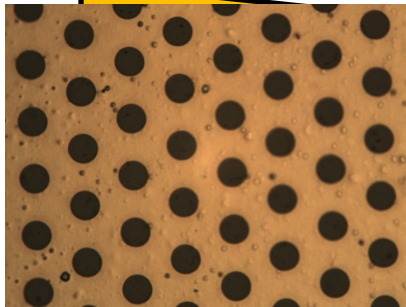


center

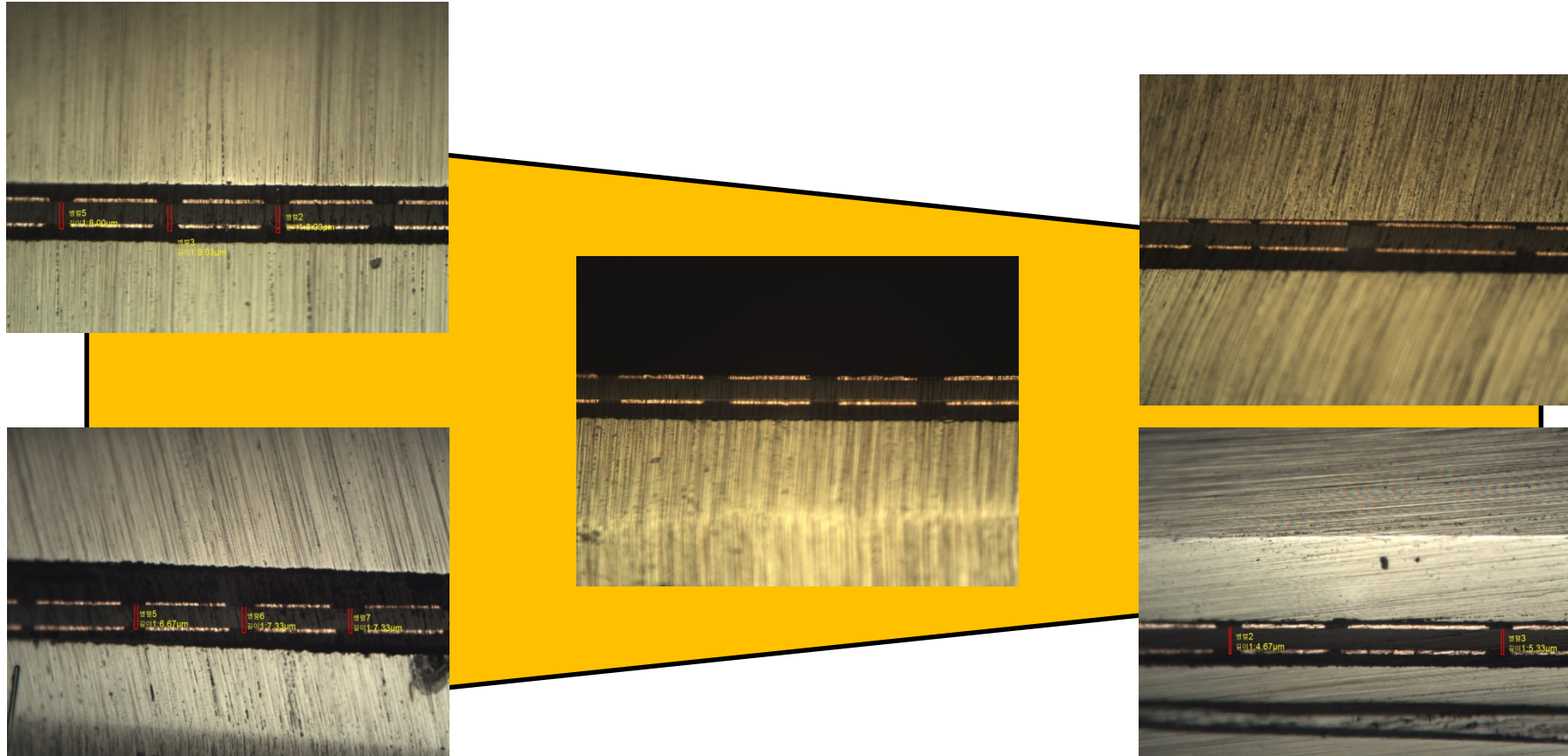


right

After Cu etching



Large size GEM (Cross-sectional view)



~ 1 m





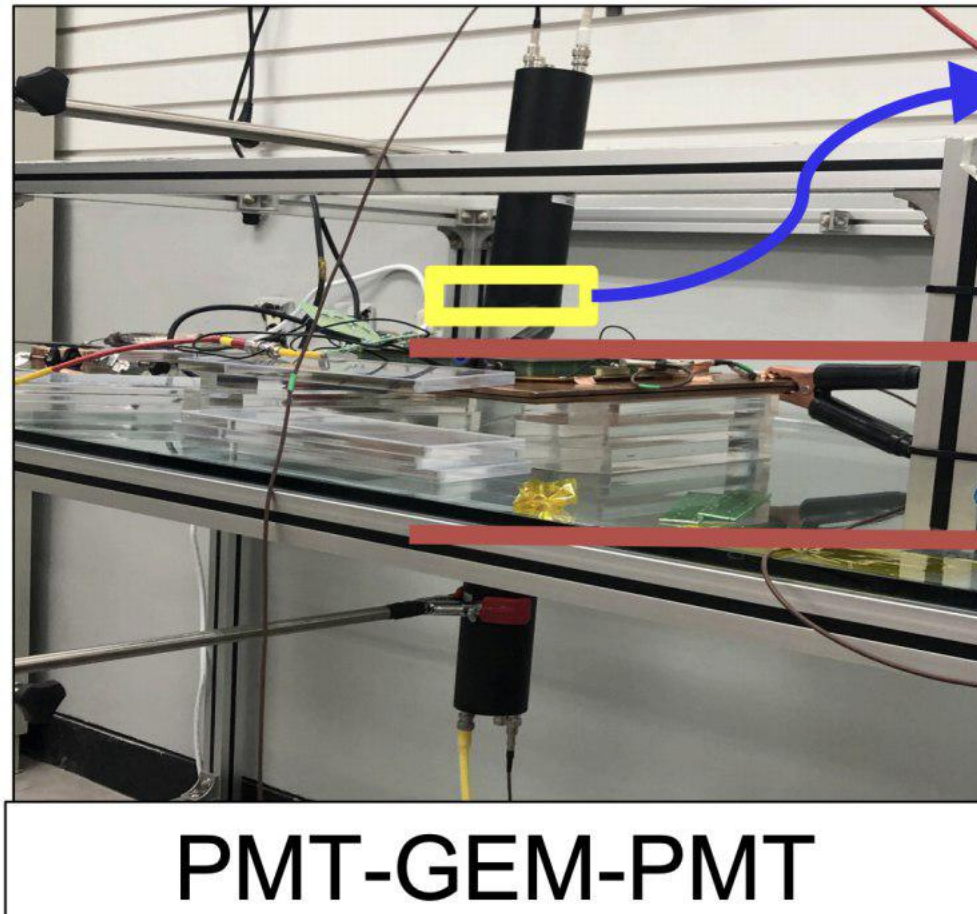
RH: 45%, HV: 507V
Impedance: 10.5 Gohm

Successful CMS GE11

Our GEM detector R&D activities

Cosmic muon study

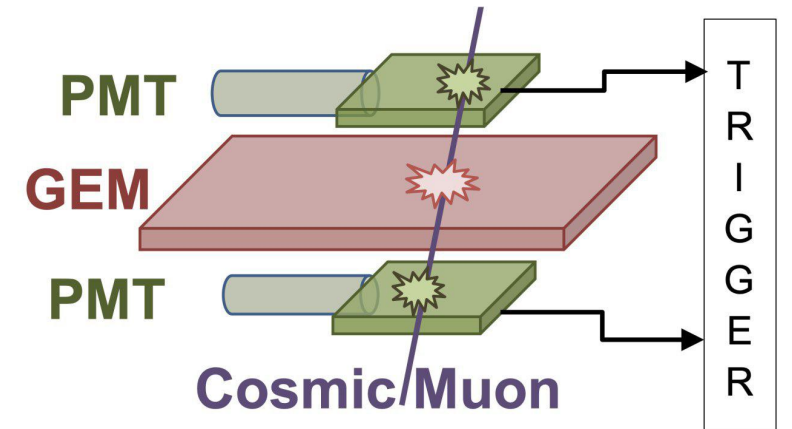
- Efficiency ~ 80% (>95% with PreAmp)
 - need to fix light shielding, ground, etc. to reach 98%



Scintillator
Area ~ 40 cm^2
Thickness ~ 1.5 cm

2017

~ 20 cm



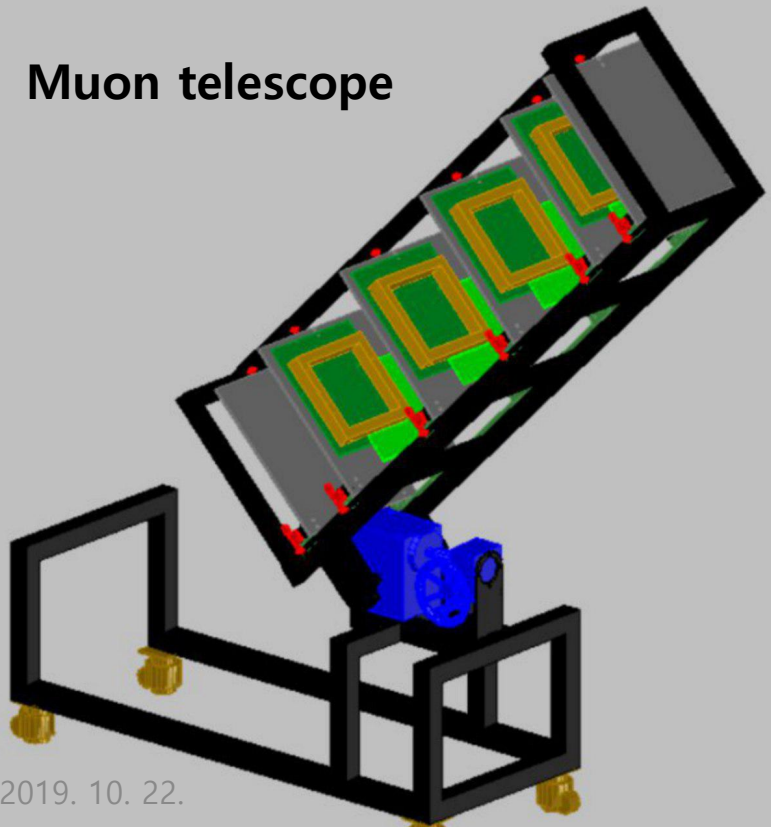
Student project

□ Double layer 2D-GEM detector

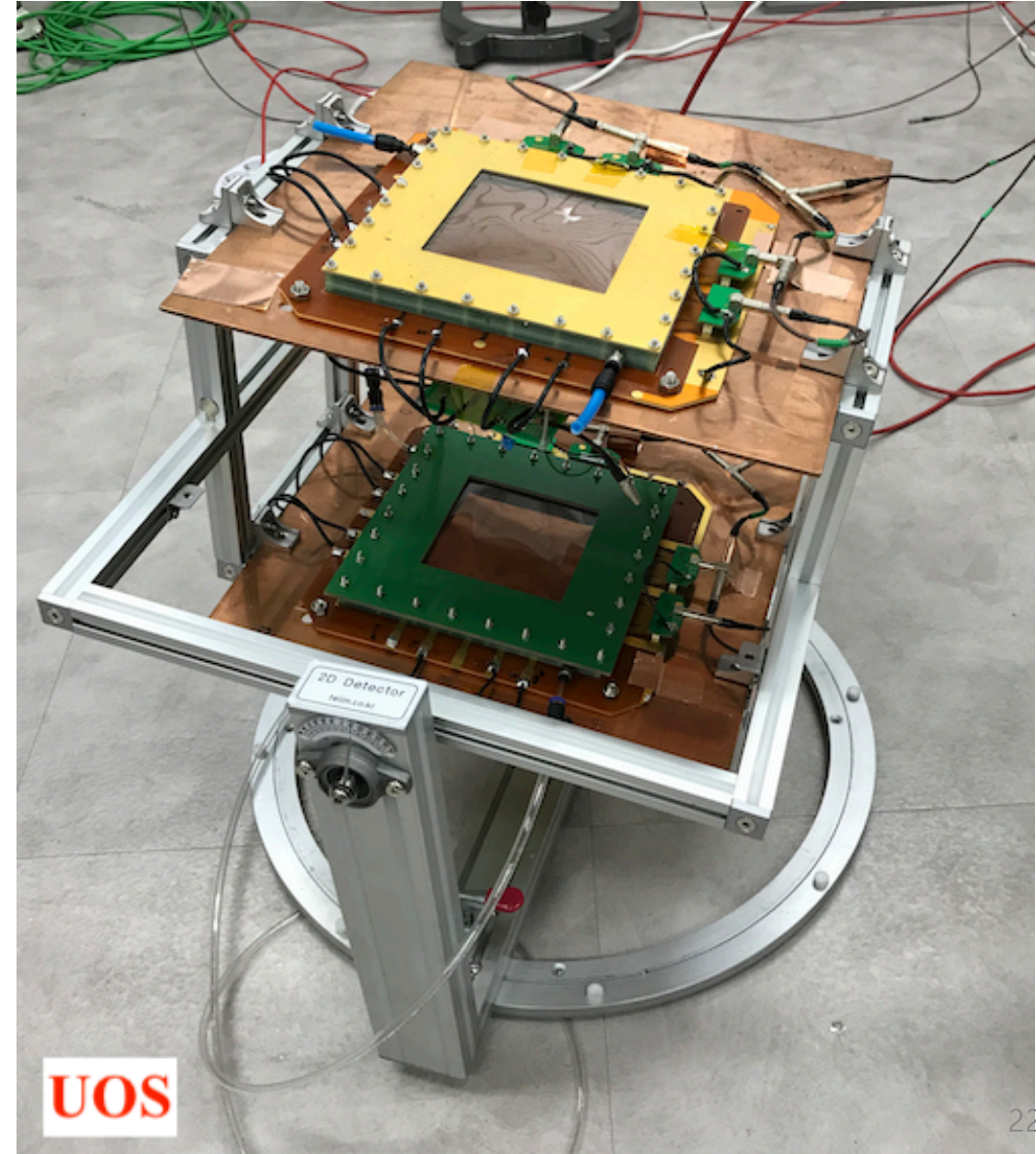
○ 2d-strip readout $(x, y) \rightarrow (\theta, \phi)$

• prove $\cos^2 \theta$ distribution

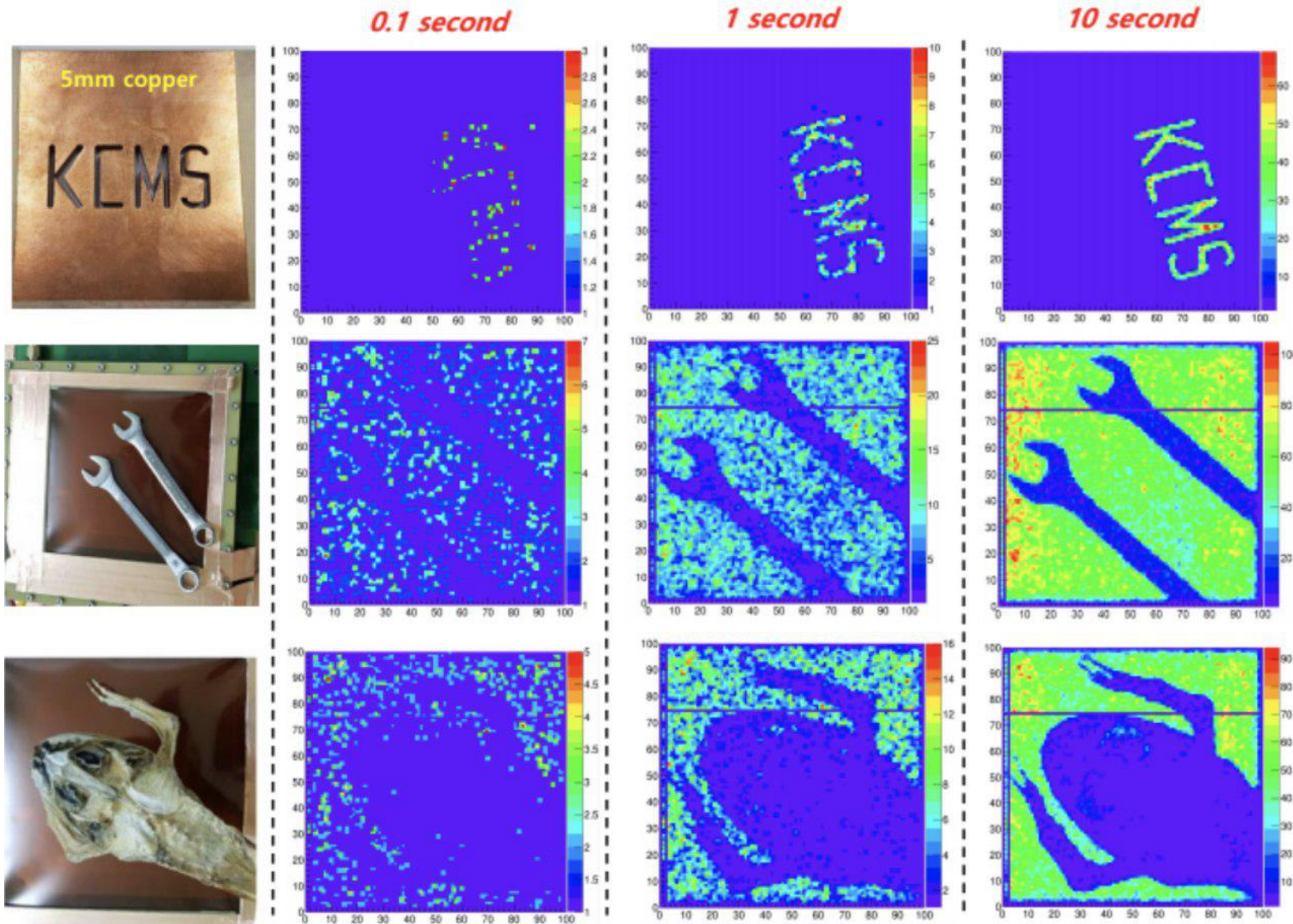
Muon telescope



2018



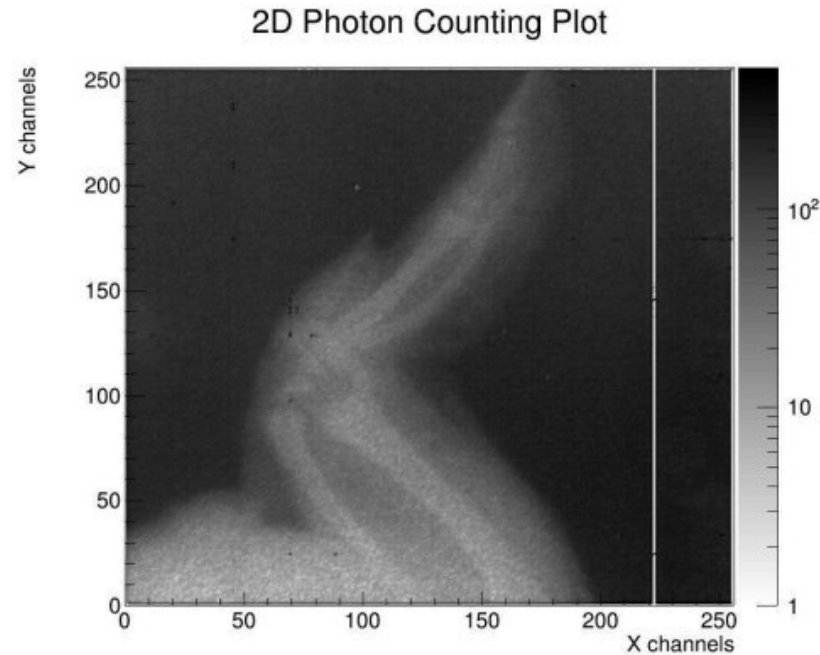
X-ray imaging (using Fe55 source)



2017

More X-ray imaging (with MECARO)

- KCMS + MECARO engineers made a fully functional X-ray imaging GEM camera



2019

Proton beam monitor (with National Cancer Center)

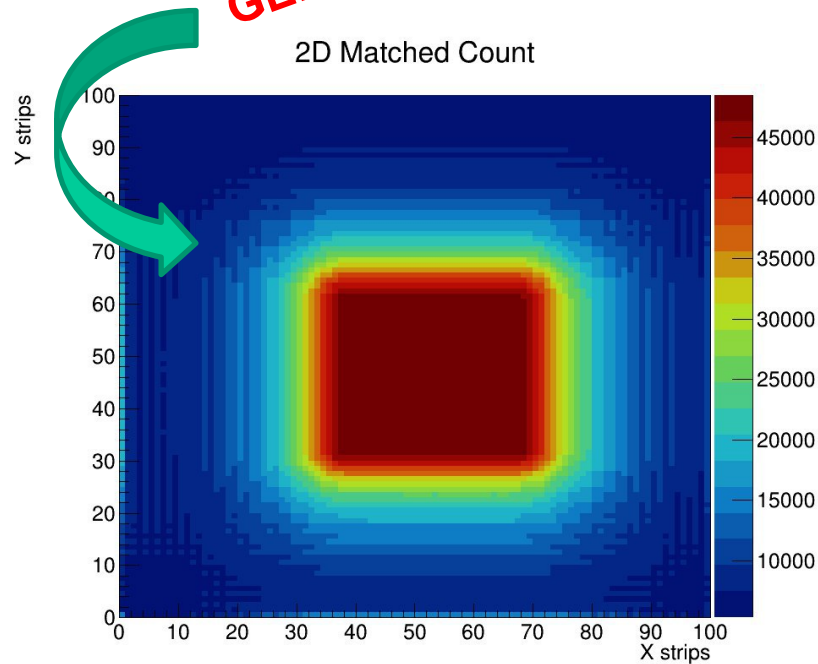
□ National Cancer Center

○ for proton beam QC

• 230 MeV proton beam

2019

GEM works for proton



“꿈의 방사선 양성자치료”

The Proton Therapy Center That Opens the Future



고정빔치료기

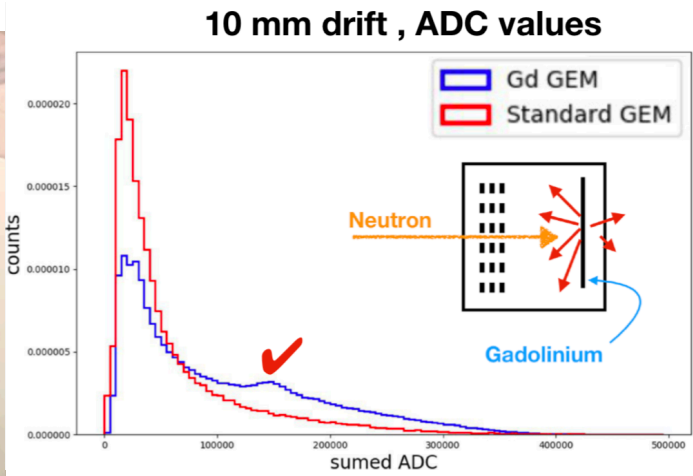
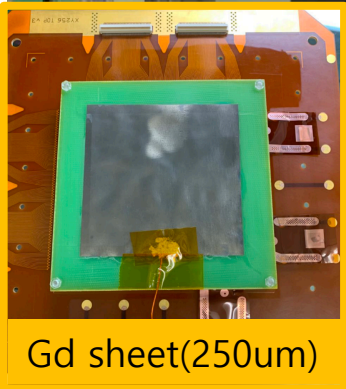
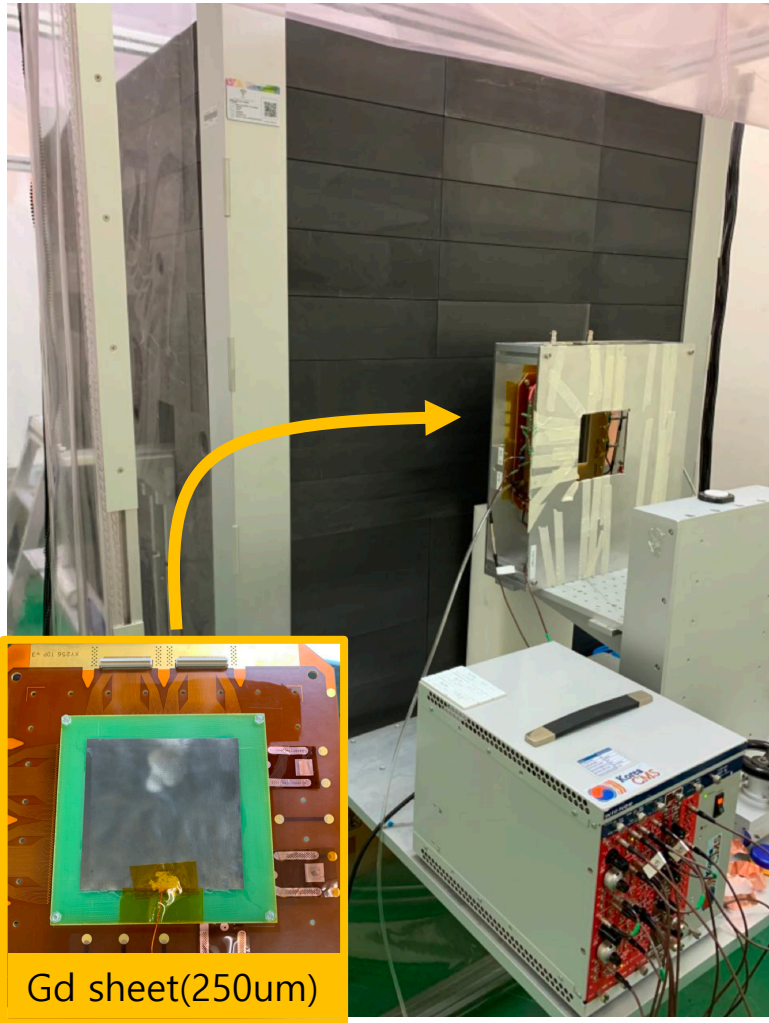
사이클로트론
230MeV의 양성자빔을 방출한다.

양성자빔 전송장치
사이클로트론에서 만들어진 양성자빔을 회전조사치료기로 이동시킨다.

회전빔치료기
암이 발생한 부위에 양성자빔을 조사한다.

국립암센터 양성자치료기
양성자 치료시설에서 양성자빔을 방출하는 사이클로트론, 양성자 빔 전송장치, 그리고 암세포에 양성자빔을 조사하는 고정빔치료기와 회전빔치료기가 있습니다.

Gd-GEM detector (with KRISS)



Source	Thermal Neutron Source			
Chamber setting	Standard GEM		Neutron(Gd) Cathode	
Direction	forward	backward	forward	backward
Frequency [Hz]	10.3	11.1	66.7	144.9
Background	2.7		2.8	

2019

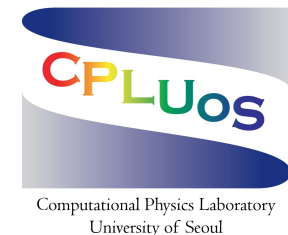
□ Gd-cathode GEM

- Thermal neutron detection
 - Backward direction setting is most efficient
- Get a bump from electron from Gd-n capture

Research Grants & M&O Funding

Our annual budget & M&O funding

- **Our main funding sources & yearly budget**
 - **CERN-Korea Program (MoST/IT)**
 - **Korea-CMS Collaboration: ~ 400 kCHF**
 - **Ministry of Education (MoE)**
 - **Natural Science Research Institute: ~ 450 kCHF**
 - **National Research Foundation (NRF)**
 - **Individual Research Grant: ~ 200 kCHF**
 - **University internal grant**
 - **Maintenance & other supports: ~ 50 kCHF**





We hope to work with you.

Thank you



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