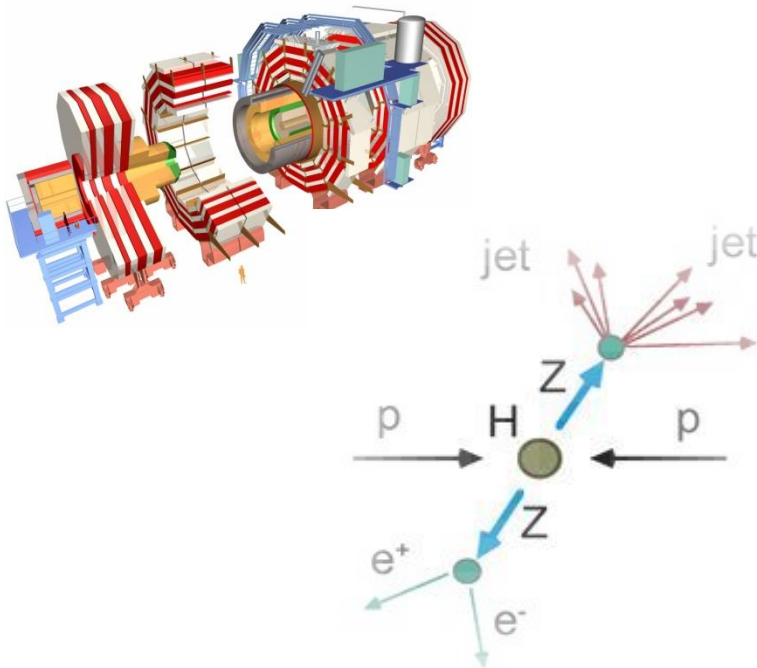




Status of GEM production in KOREA



University Of Seoul

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Minkyoo Choi



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Introduction to GEM production team & Facility

- **KOREA GEM production team**

- **University of Seoul : 1 Prof , 1 post-doc , 1 engineer ,1 Ph.D student**



- **Mecharo : 2 Manager , 1 engineer , 1 technician**

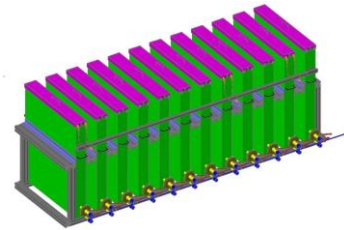
- **Production site**

- R&D and Production Facility
- Clean room : 1300 m²



- **Production room A for small-size GEM foils(<math><45\times 45\text{cm}</math>)**

- **A-room is for the R&D & small quantity order.**



- **Production room B for large-size GEM foils(<math><150\times 100\text{cm}</math>)**

- **B-room is for mass-production & large size-order.**

Also B-room has the machines for Q/C.

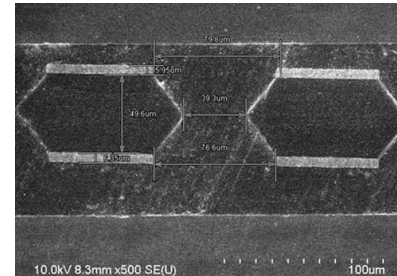
(Optical inspection, Current measure)



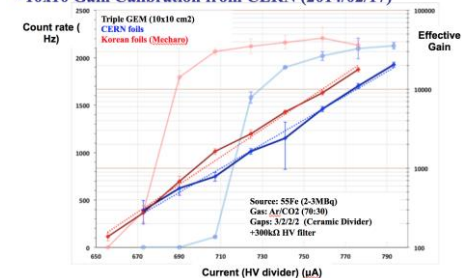


A brief history of GEM production in KOREA

- A first version of GEM was produced in Nov.2012.
 - We developed by own production method double side litho + Cu etching + PI etching
- KOREA team and CERN signed the MOU for the GEM tech in July 2013.
 - We started producing HD GEM since then.
 - Uniformity is $\sigma < 2\mu\text{m}$.
 - Presented in MPGD2013
- We made a first version of Large GEM in Dec.2013.
- 10 x 10 Gain calibration at CERN in Feb.2014.
- Ongoing work :: 30x30 Gain calibration at CERN ,comic muon detector build at UOS

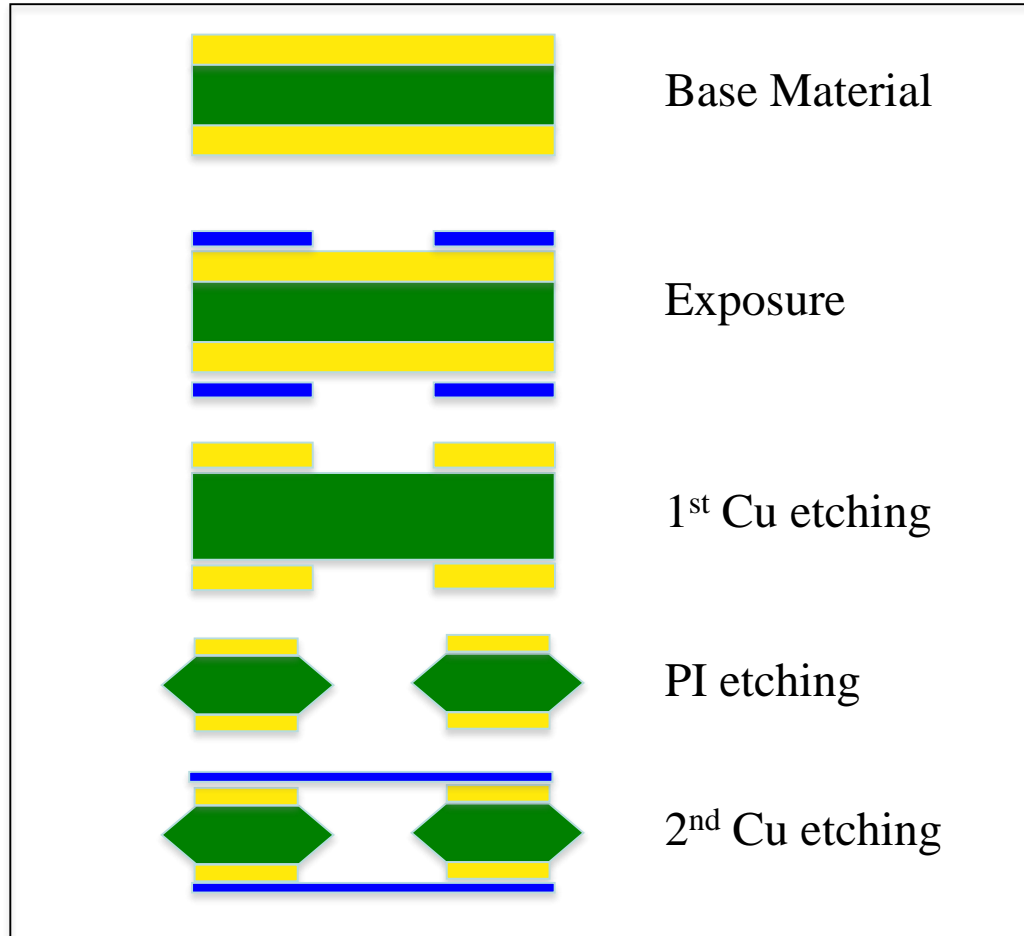


• 10x10 Gain Calibration from CERN (2014/02/17)





GEM production by Double mask method



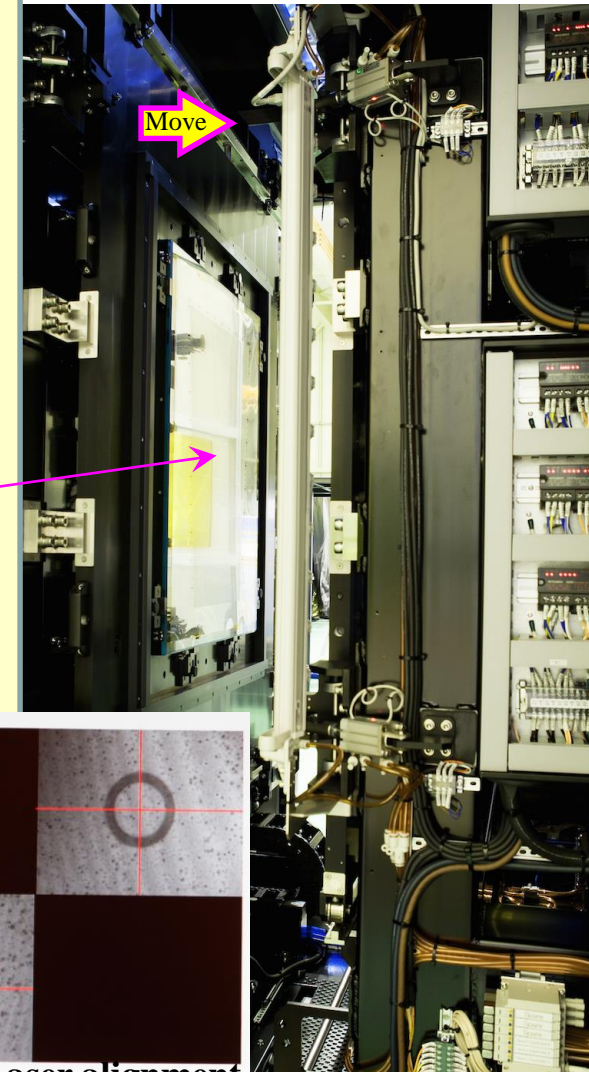
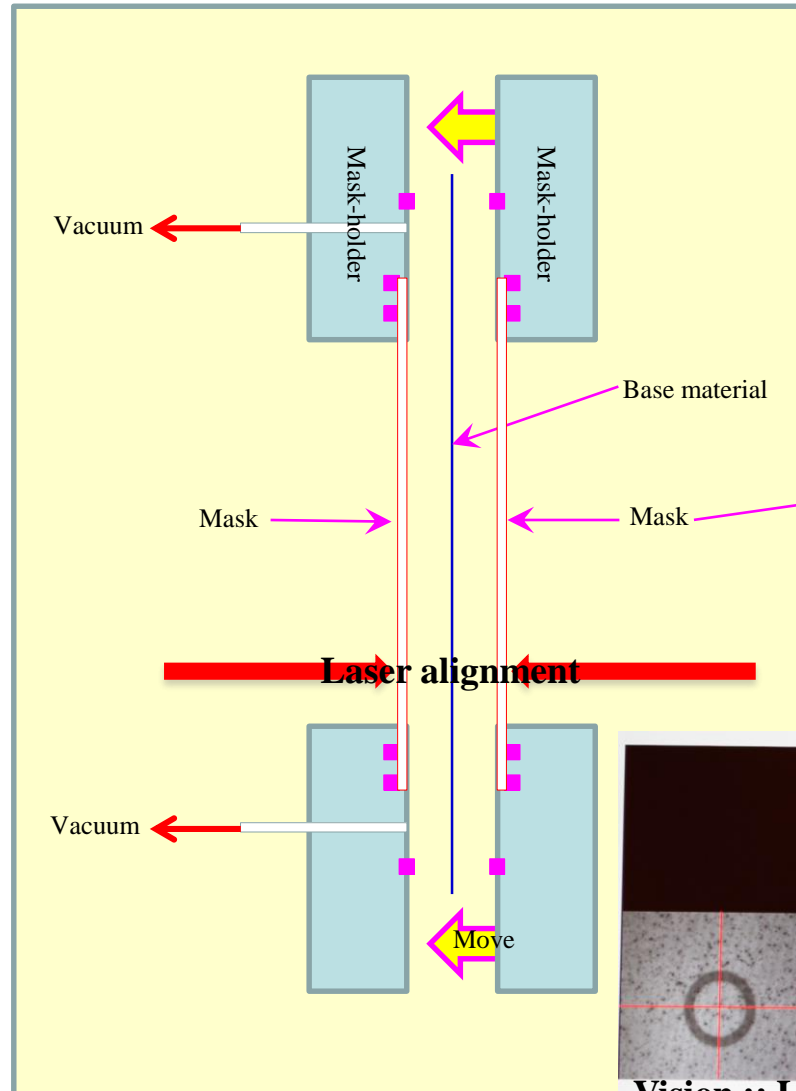
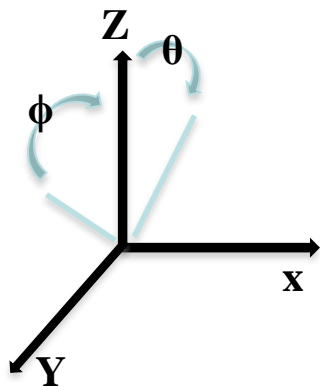
Merit ::

1. Simple process
2. Inner-hole's position is always center.
3. control inner-hole size (range ::25um~60um)

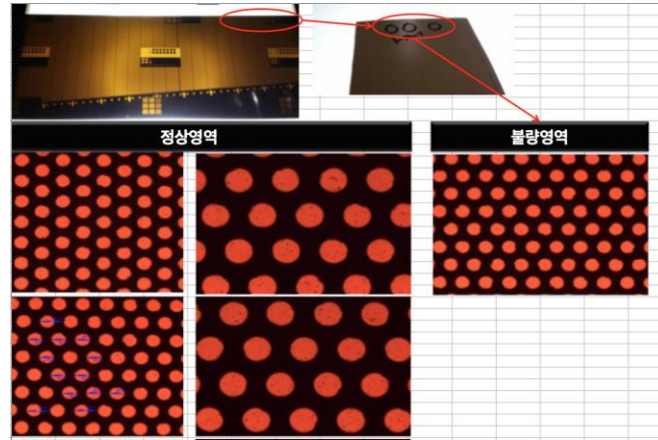
Demerit ::

1. Have to align upper hole with down hole(It's not easy).
We are able to align upper with bottom within 1um.

Movement Range
 $0\text{mm} < X, Y, Z < 2\text{mm}$
 $0\text{ deg} < \Theta < 2\text{ deg}$
 $0\text{ deg} < \phi < 2\text{ deg}$



Vision :: Laser alignment



1st test sample(July.2014) :: first try to make a large GEM foil with the double-side method. Not successful due to bad mask attachment.

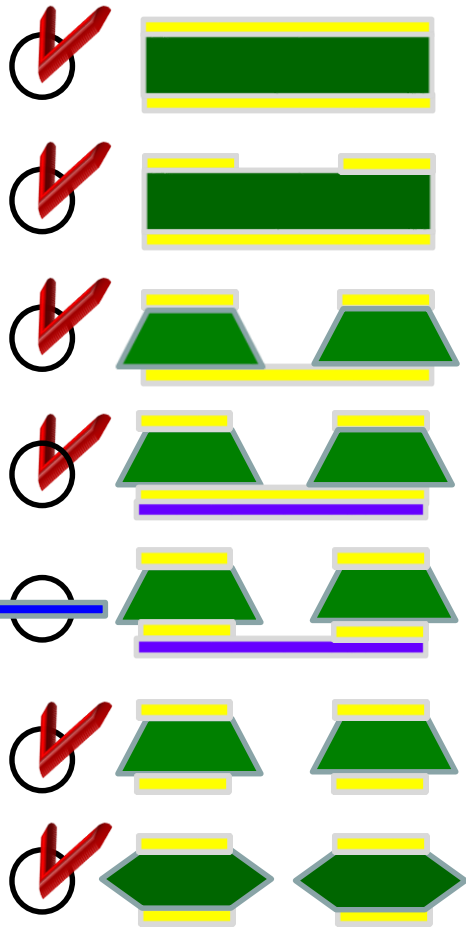
2nd test sample(Aug.2014) :: successful UV exposure was achieved. Problems with hole shapes on some areas

3rd test sample(Sep.2014) :: perfect UV exposure, perfect hole shape, precision hole-to-hole alignment achieved

- conclusion: we can do it! (if we can use this large lithography machine for production)



GEM production by Single mask method



1. Raw material

2. Top Cu Hole Etching

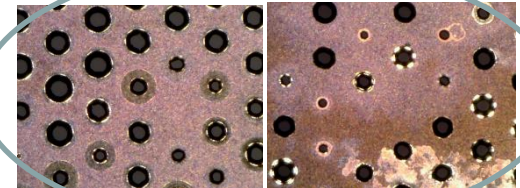
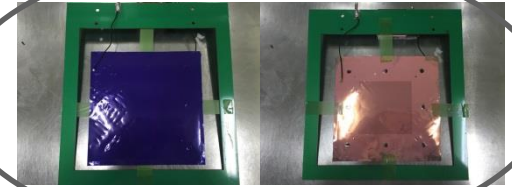
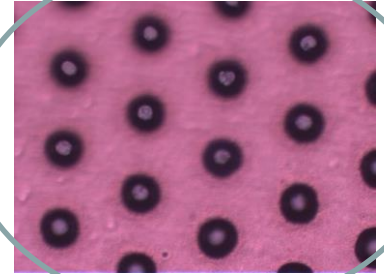
3. PI Etching

4. Bottom-Cu Laminating for Protection

5. **Bottom-Cu Electro Etching**

6. Remove Laminating Film

7. Second PI Etching





Summary



- We successfully developed a large size GEM foil production method using double-side etching technology
- Need to buy a \$1M machine for large size UV lithography machine. we are studying to production by single mask method.
- For Mass production, We have to reduce human's operation on stream.
 - » Electro-Cu etching step need to manpower in single mask process.
- We are producing 150 GEM foils(10x10) & 50 cathode in KOREA. It's check point for rate of production.



Future plan



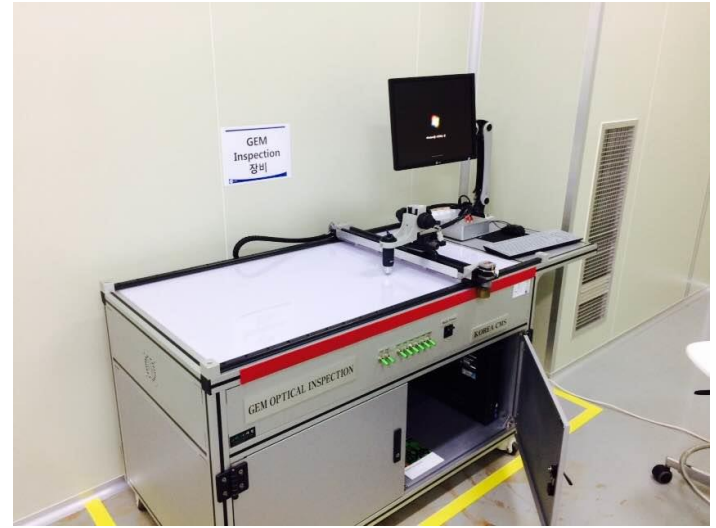
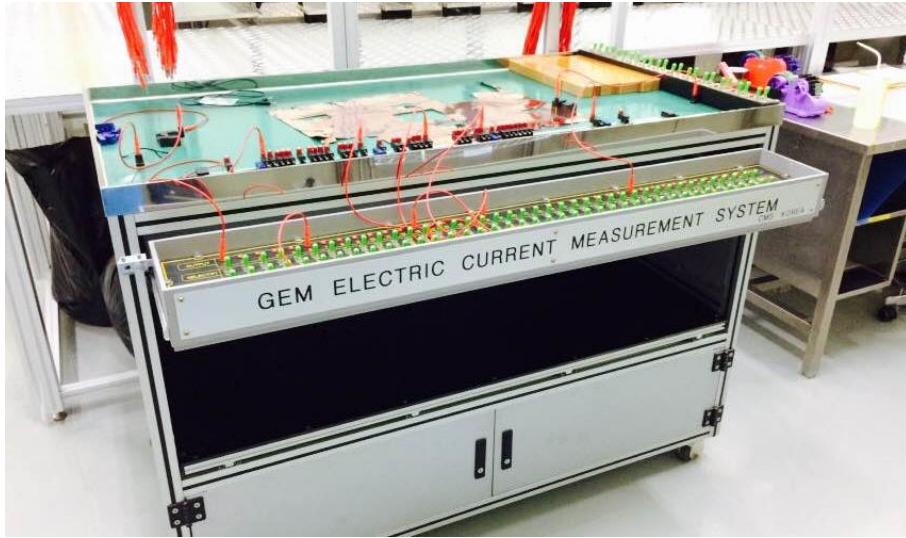
- **We'll finalise the single mask production study shortly. By the end of this year, we'll have both methods (double-side and single-side) in hands!**
- **Future plan for productions: 100 10x10 small GEM foils (mid 2015), ship 50 foils to Rui**
 - 10 GE11 GEM foil test production and QC (late 2015)**
 - 20 or more GE11 GEM foil production (early 2016) for YETS 2016-2017.**

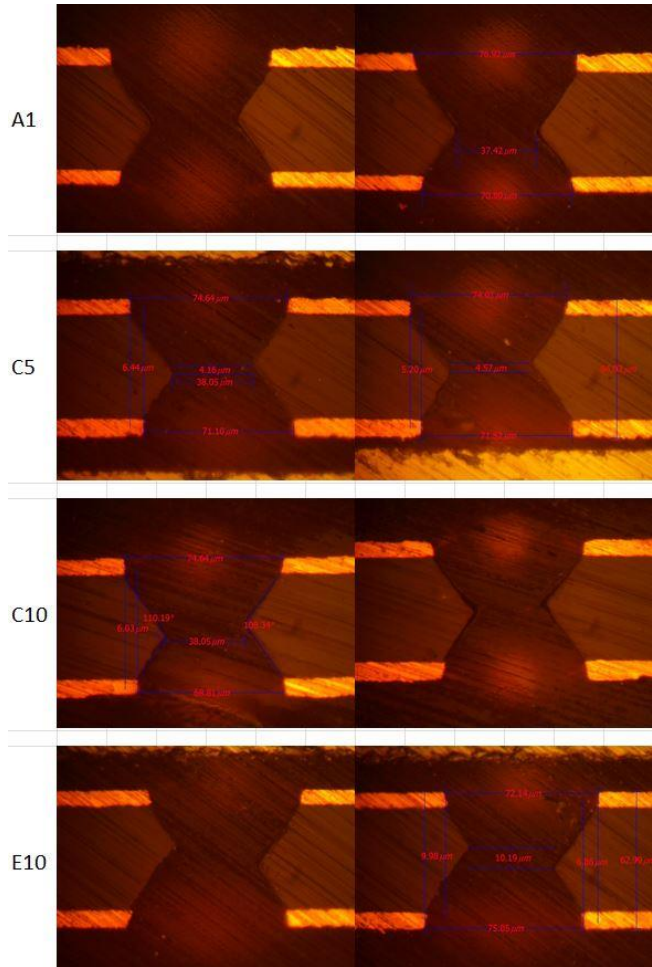


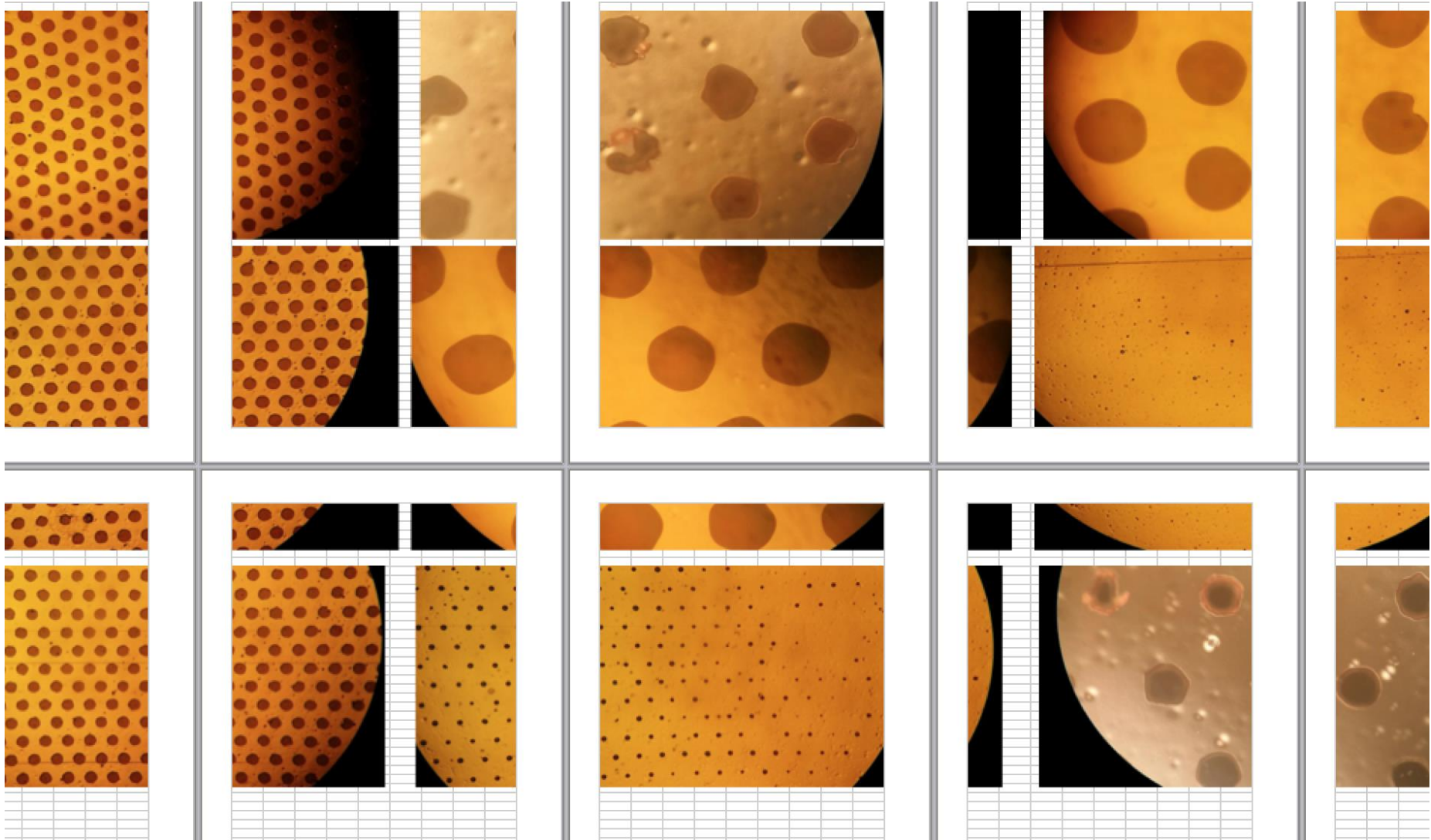
Thank you



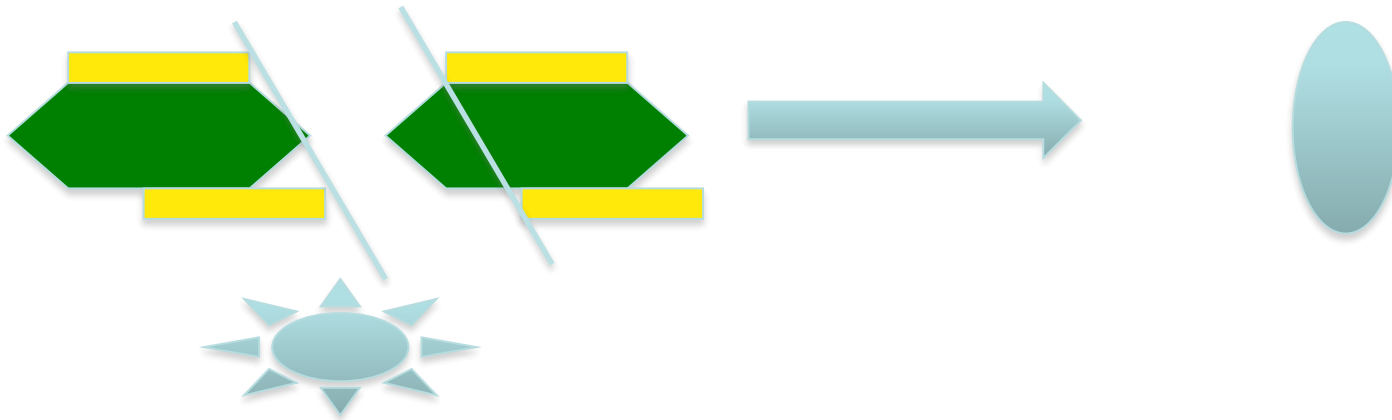
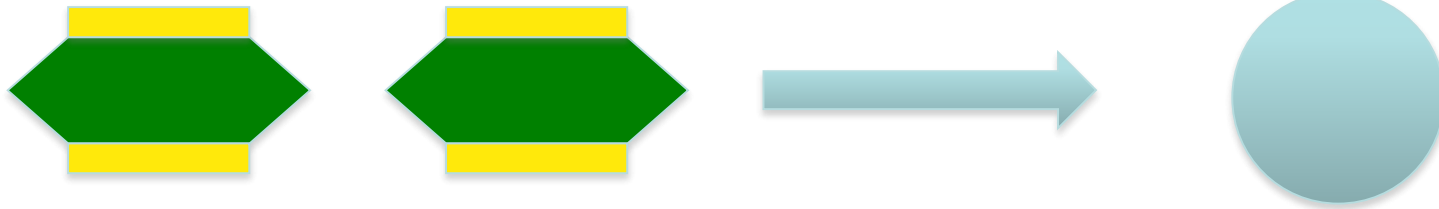
Back Up







Check the alignment





CERN-GEM vs KCMS-GEM



• 10x10 Gain Calibration from CERN (2014/02/17)

