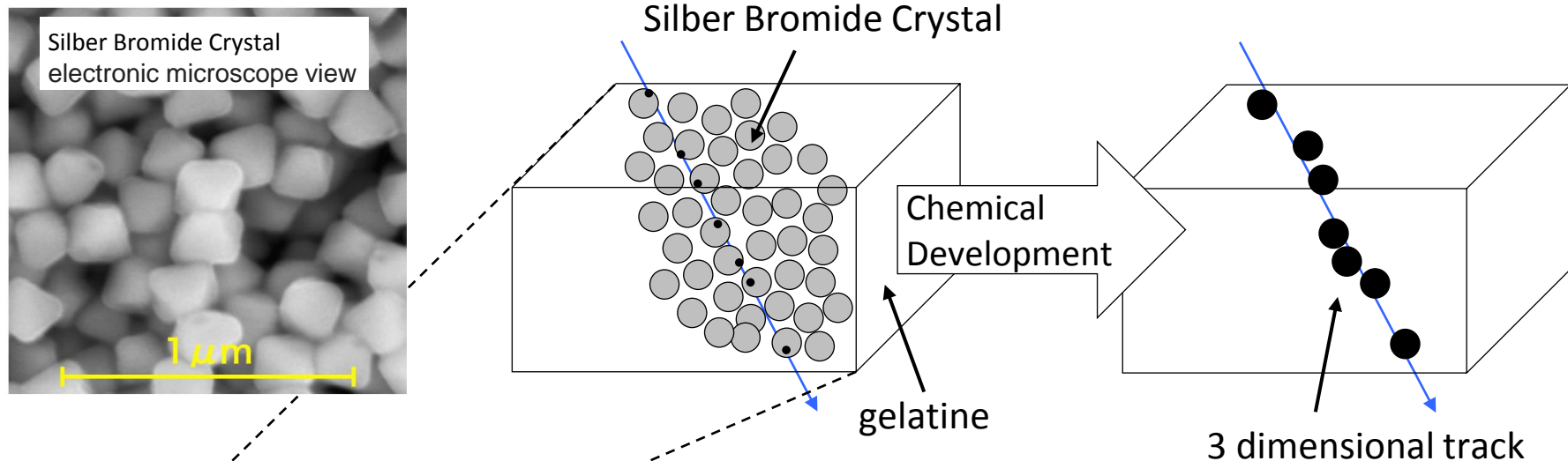


Emulsion production capability at Nagoya University

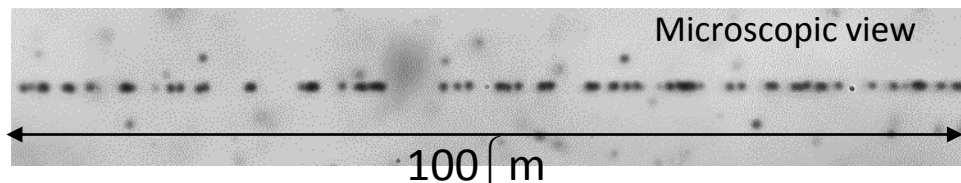
Akira Nishio, Kunihiro Morishima
Nagoya University

Nuclear emulsion

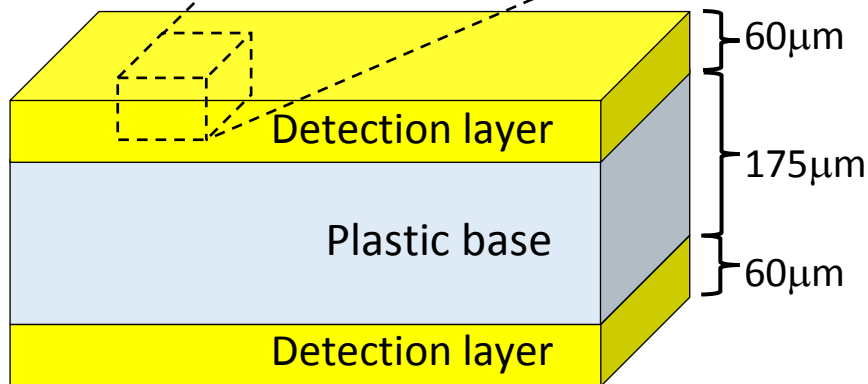
Visualization of trajectories of charged particles in three dimension



☆ High spatial resolution ($< 1\mu\text{m}$)



- High spatial resolution
 - Sensitive to Minimum Ionizing Particles
- Detection of tau decay

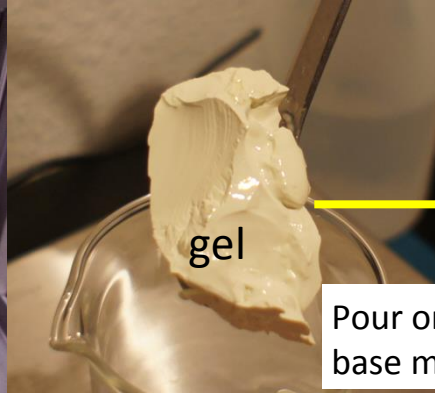
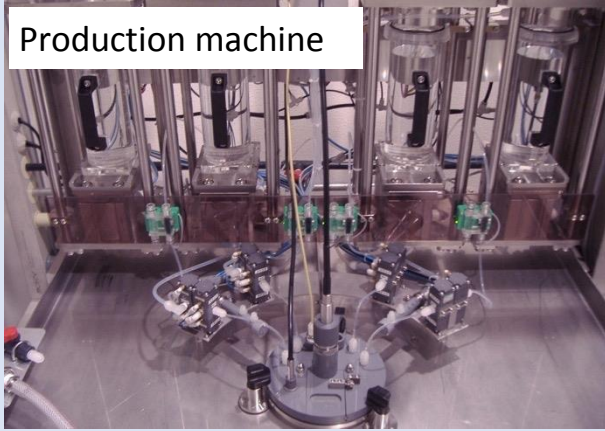


We need to produce emulsion films by self-made

Flow chart of emulsion production

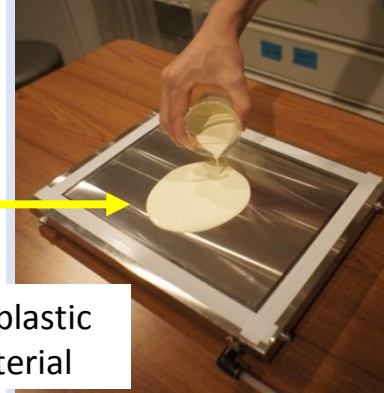
Emulsion gel production

Production machine



Pour on plastic base material

Pouring

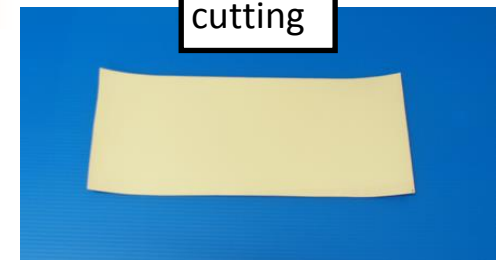


※Dark room

Drying



cutting



Humidity control

assembling

Fix on plate

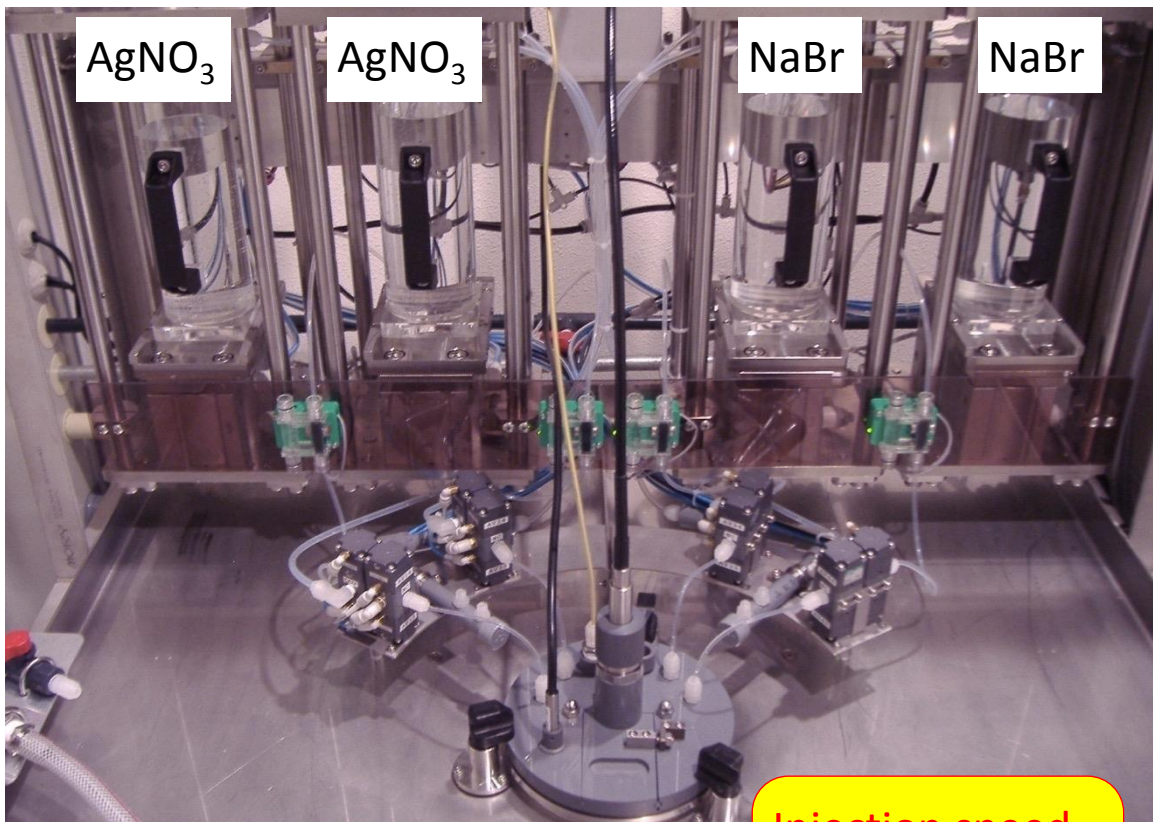


Vacuum pack

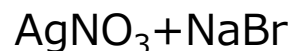


Light shielding, keeping humidity, water shielding

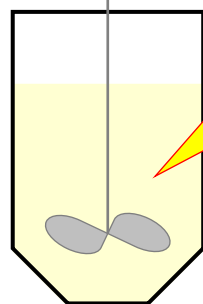
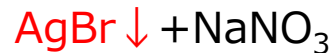
Gel Production Machine at Nagoya University



Chemical reaction



→



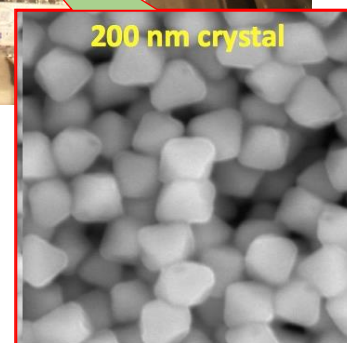
Injection speed
Mixing speed
Temperature

Crystal size
Crystal shape

chemical

Sensitivity
Stability

200 nm crystal

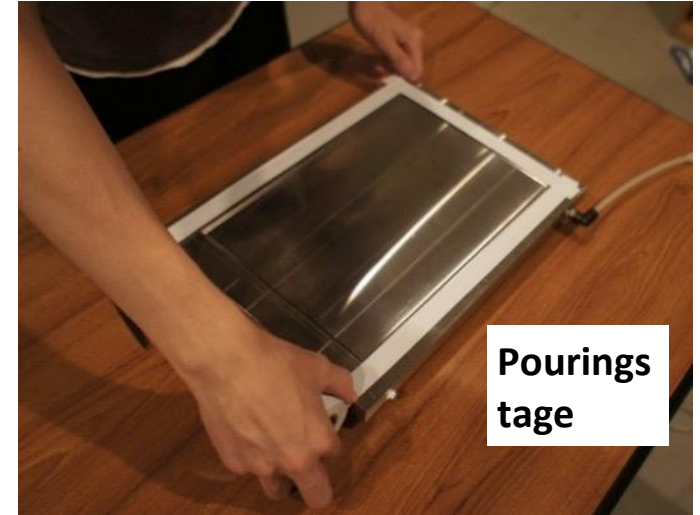


Coating technique based on traditional method

1. melt emulsion gel



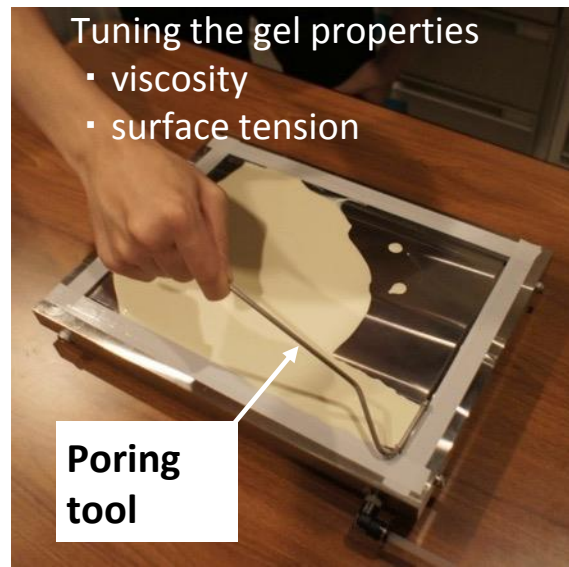
2. Fix plastic base on the stage



3. Pour the gel



4. Spread the gel



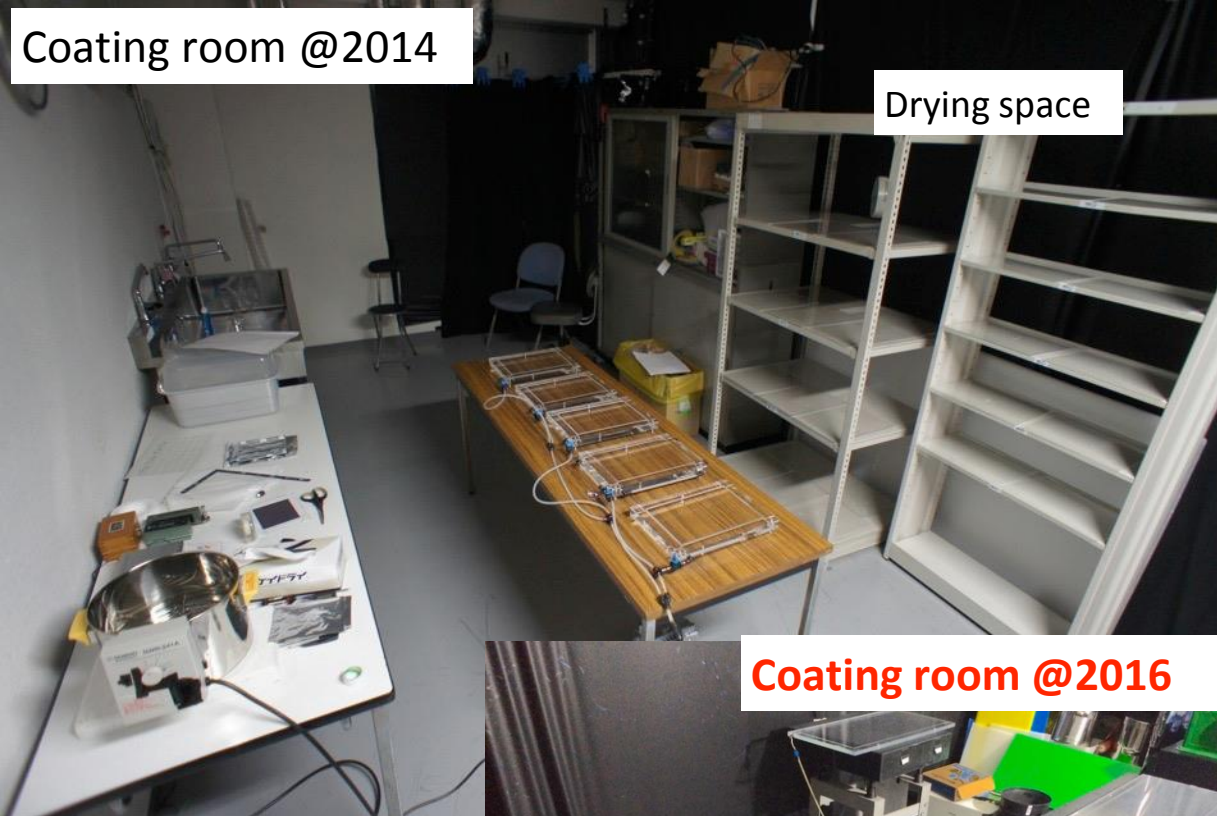
5. Dry after setting

Tuning the drying condition

- humidity
- temperature
- wind



Coating room



Process flow of self-made emulsion film production



Day 1

2

3

4

5

6

7

Gel production	Pouring (first surface)	Drying (first surface)	Pouring (second surface)	Drying (second surface)	Cutting Humidity control	Packing
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1 week

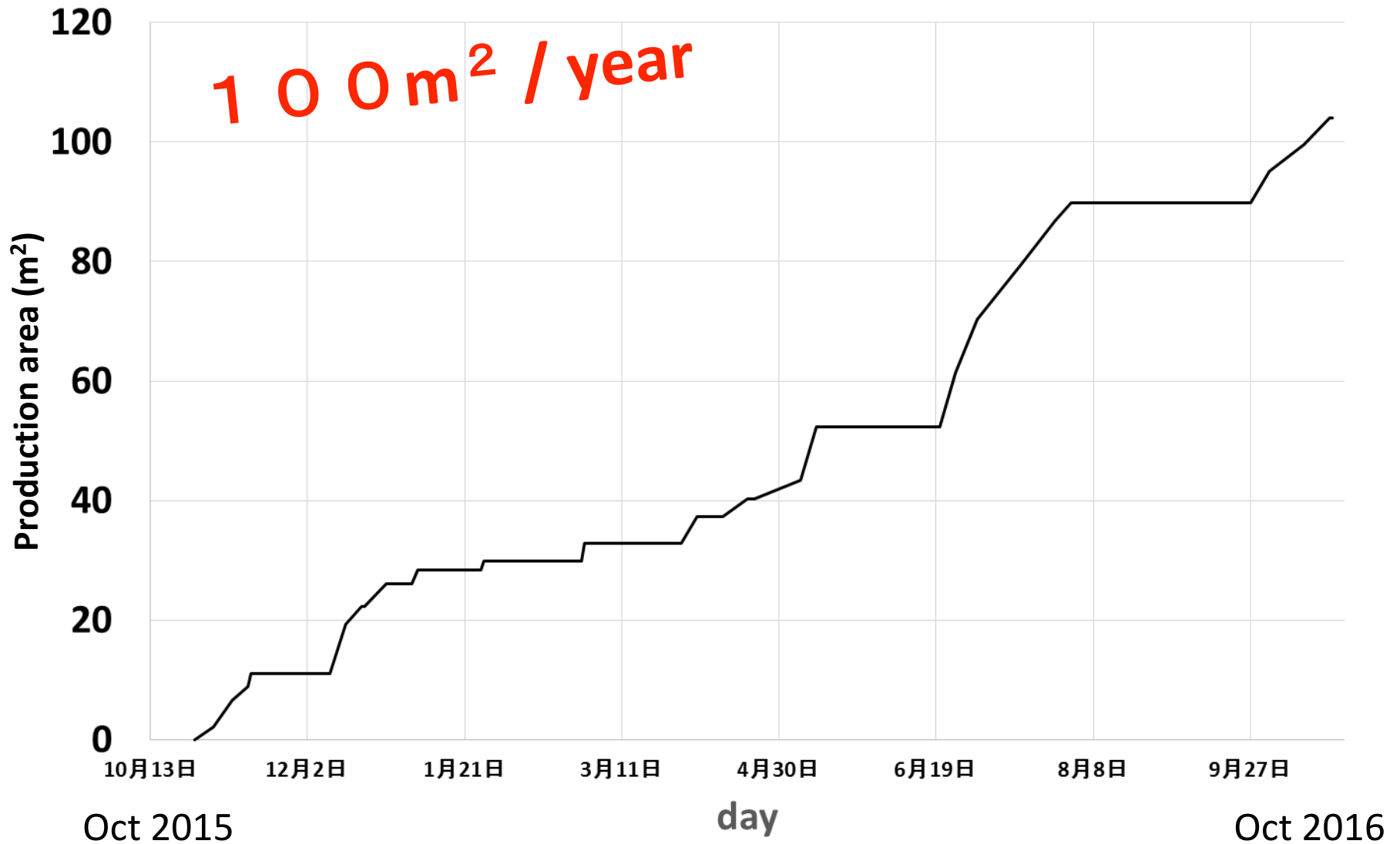
Production speed = 9m^2 area detector / week
4 persons working / day

9x speed up in 2 years

Performance at 2014 collaboration meeting

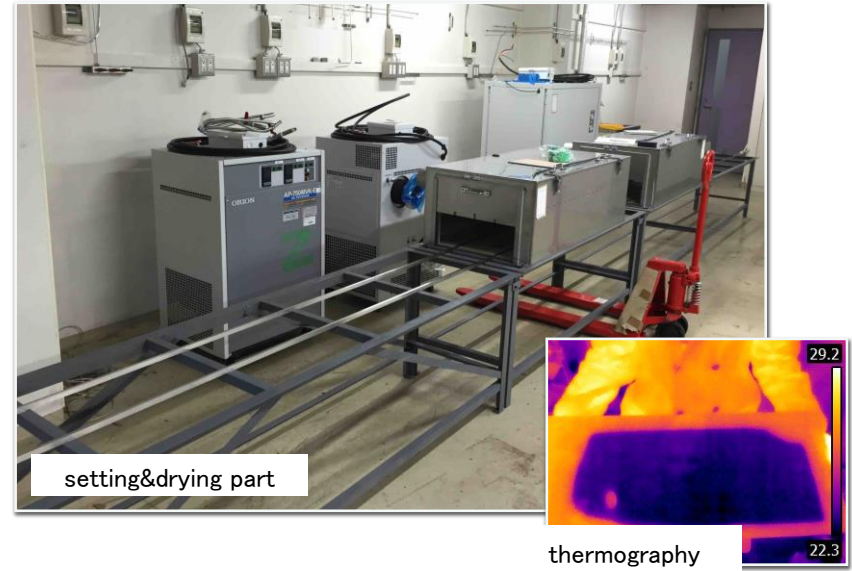
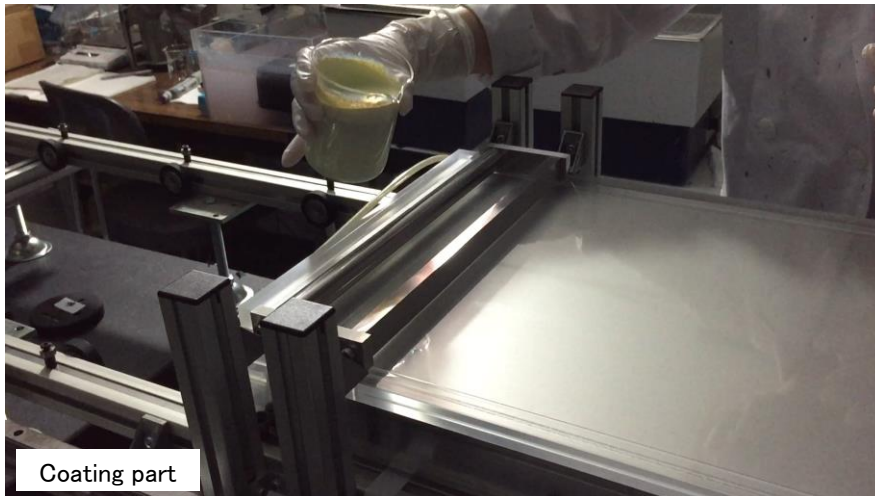
1m^2 area detector / week
3 persons working / day

Performance of Emulsion Production



Development of Machine Coating System

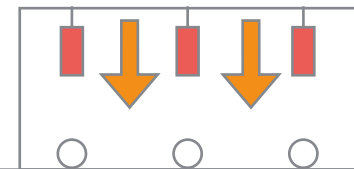
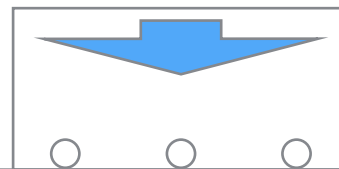
Under preparing ...



Coating part (1min)

Setting part (2min)

Drying part (7min)



20m²/week ~ 1000m²/year

Thickness uniformity $\pm 5 \mu\text{m}$

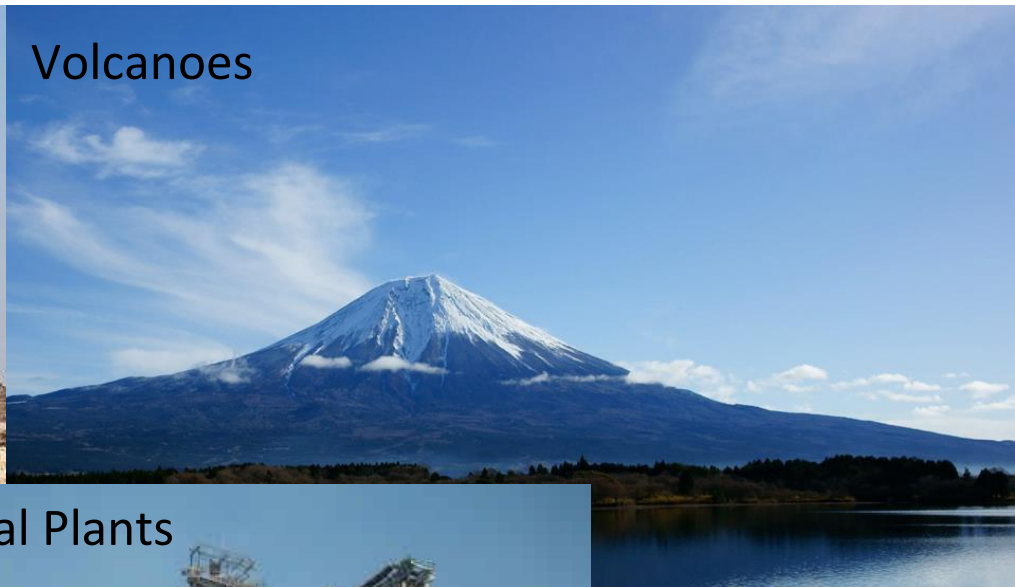
Emulsion for Muography

Potential for innovative industrial technology

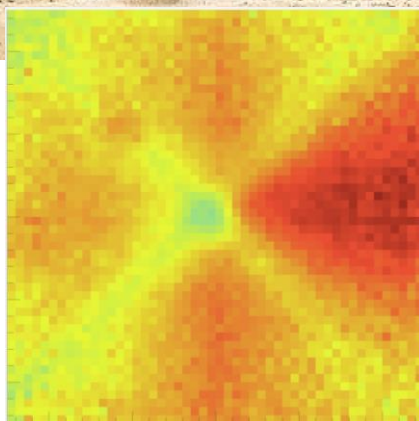
Pyramids



Volcanoes



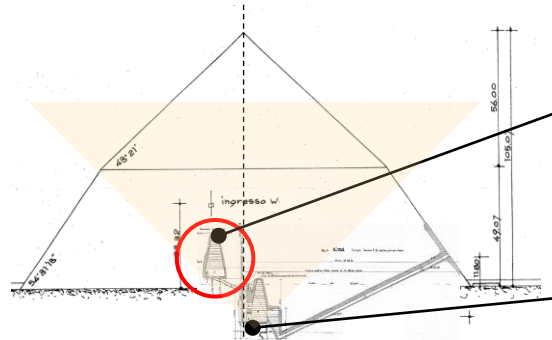
Industrial Plants



Fuji Film company are very cooperative for development of muography
This is essential for SHiP experiment (several 1000m² emulsion experiment)

Emulsion for Muography

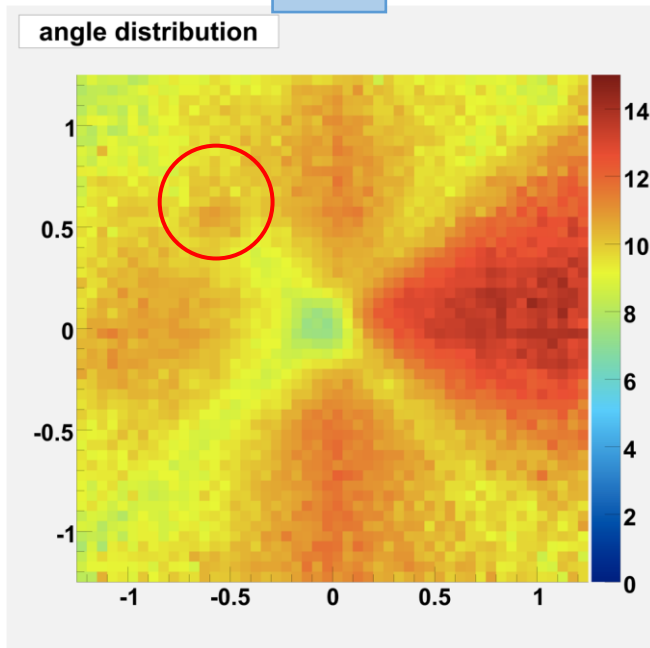
Bent pyramid



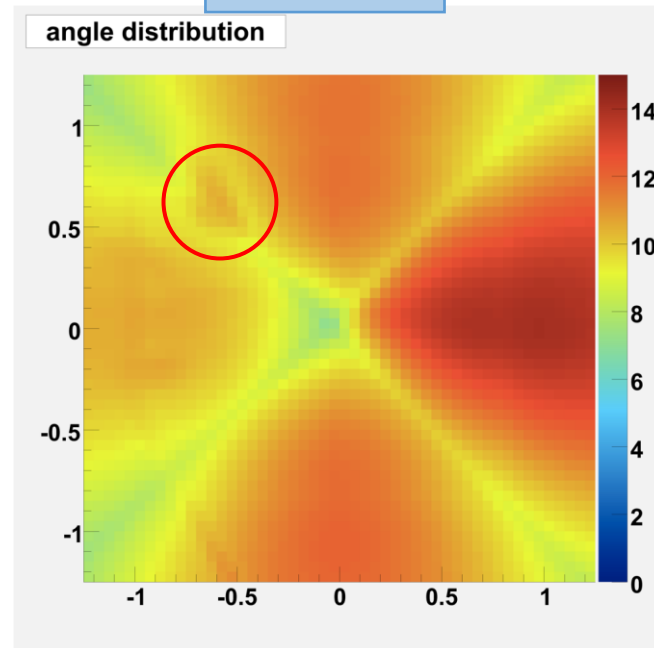
Upper chamber

Emulsion in lower chamber

Data



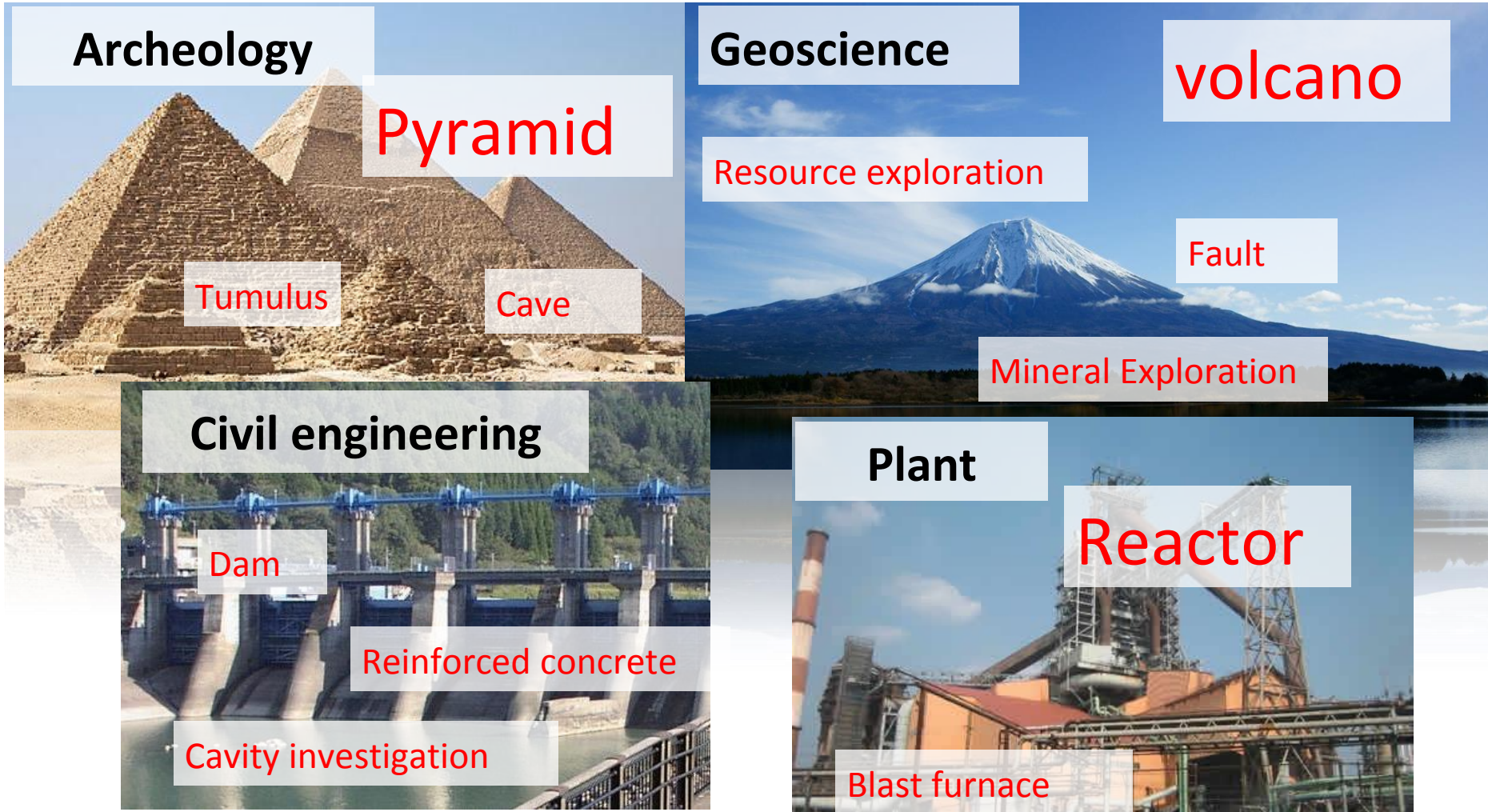
Simulation



This is first validation of muography of the chamber inside the pyramid !!

Emulsion for Muography

Potential for innovative industrial technology



Fuji Film company are very cooperative for development of muography
This is essential for SHiP experiment (several 1000m² emulsion experiment)

Summary

- We are developing emulsion technologies (gel, production) at Nagoya University
- We can produce $9\text{m}^2/\text{week} \sim 400\text{m}^2/\text{year}$
 - Aiming to reach $1000\text{m}^2/\text{year}$
- We are developing machine coating system to increase performance and production speed
 - Current driving force is Muography.