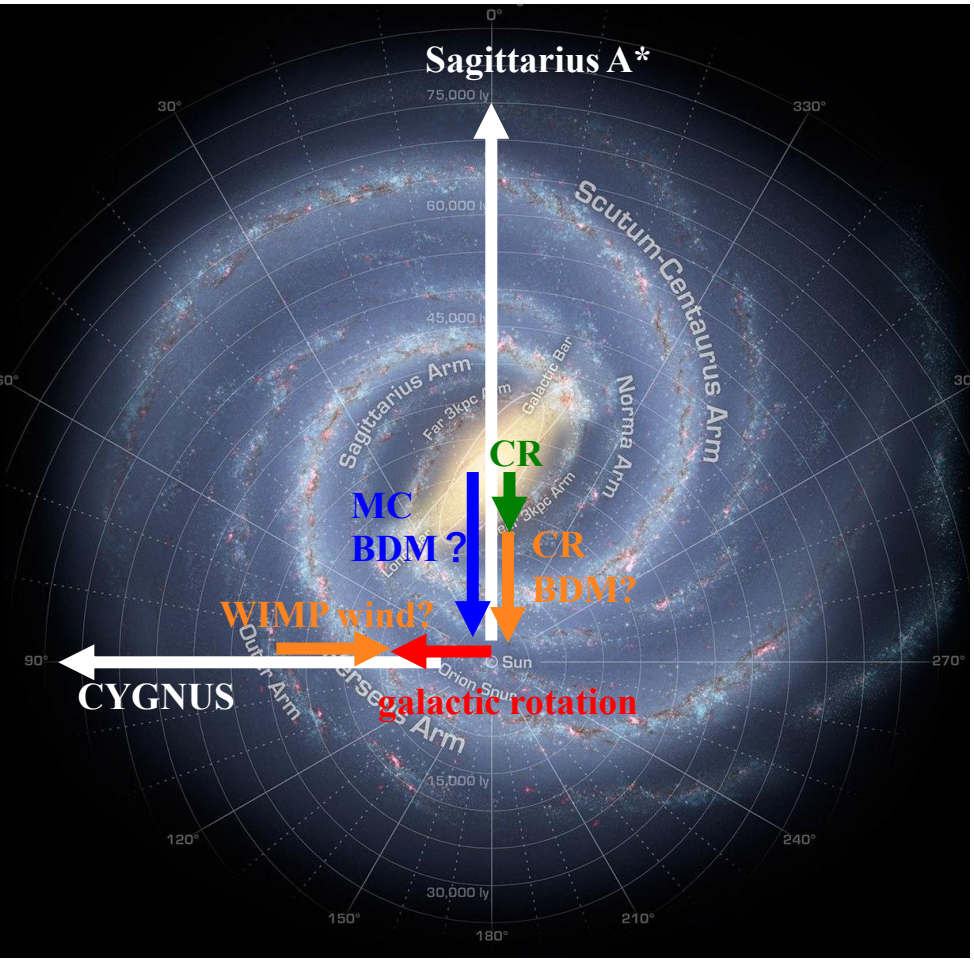
LNGS Activity Report

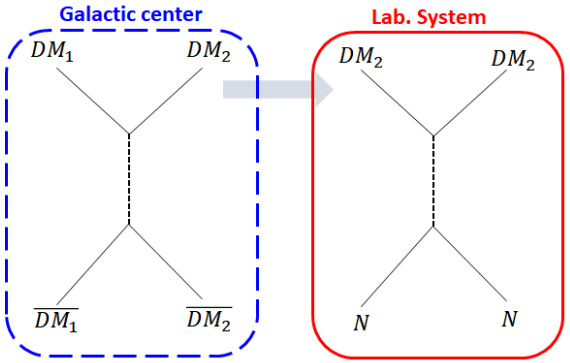
T. Asada

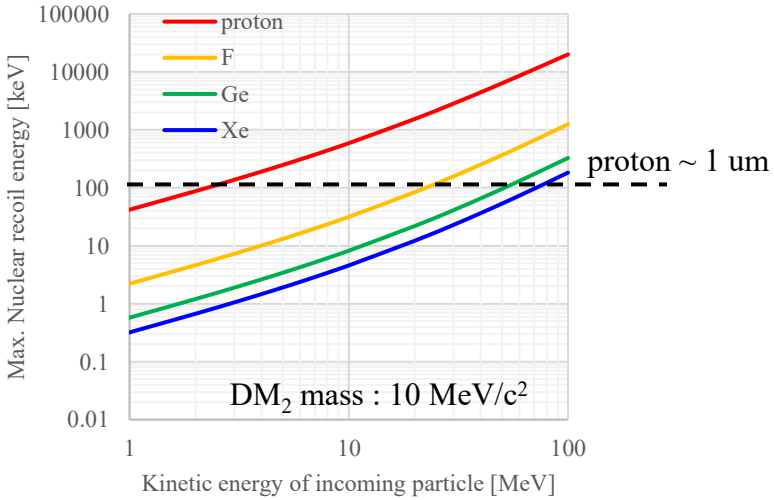
2025/8/1

Target



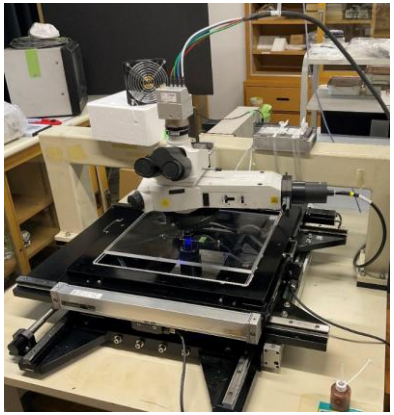
multi-component enhanced dark matter
→the target is light mass DM2

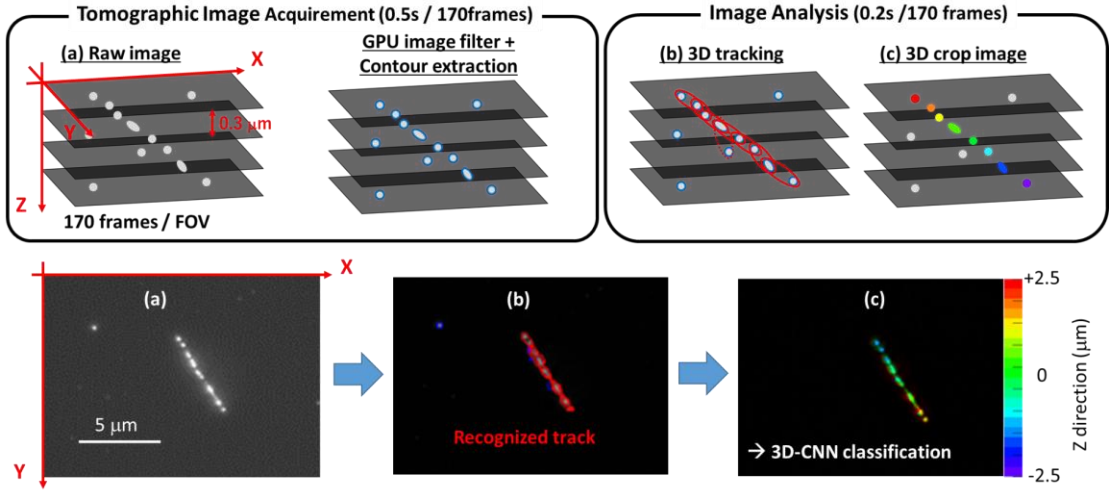




Chain analysis system

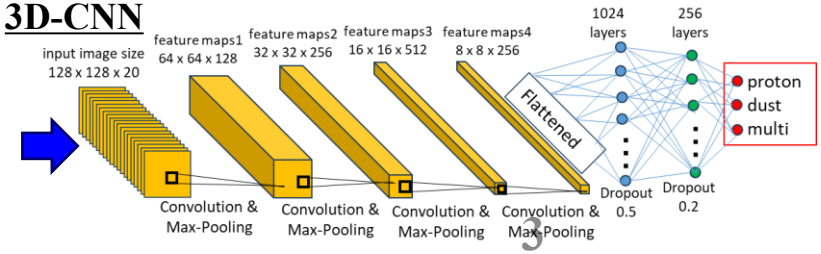
PTS 2.2 (Kanagawa univ)

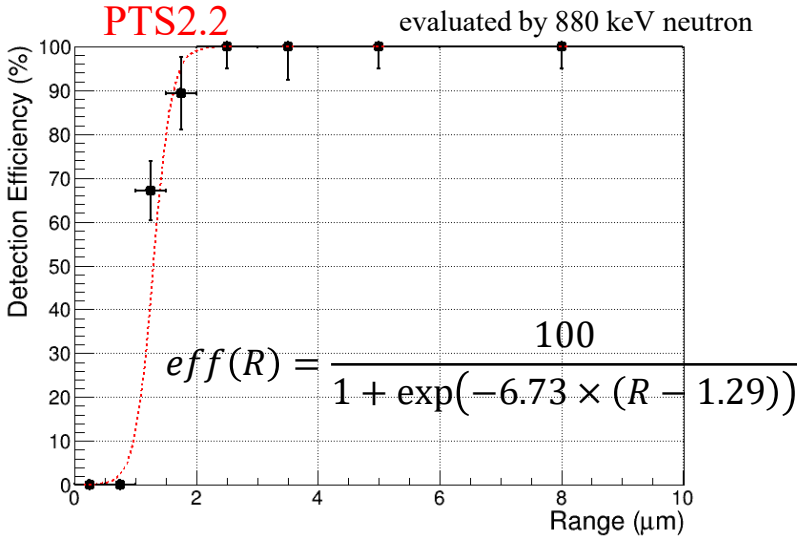




3D image

3D-CNN

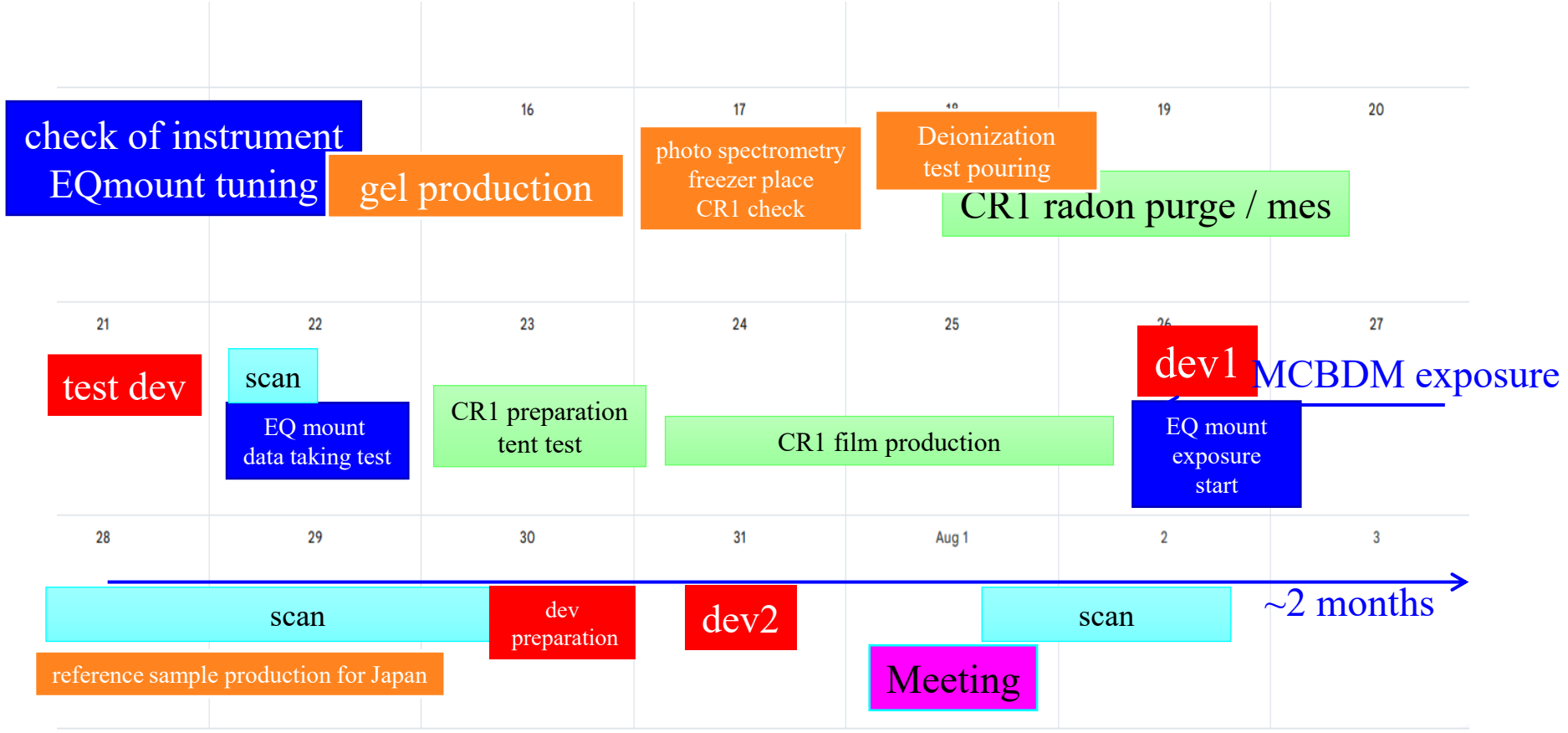




1.1 kg/year/machine with 1 um threshold

no background for > 1μm proton signal at neutron Run

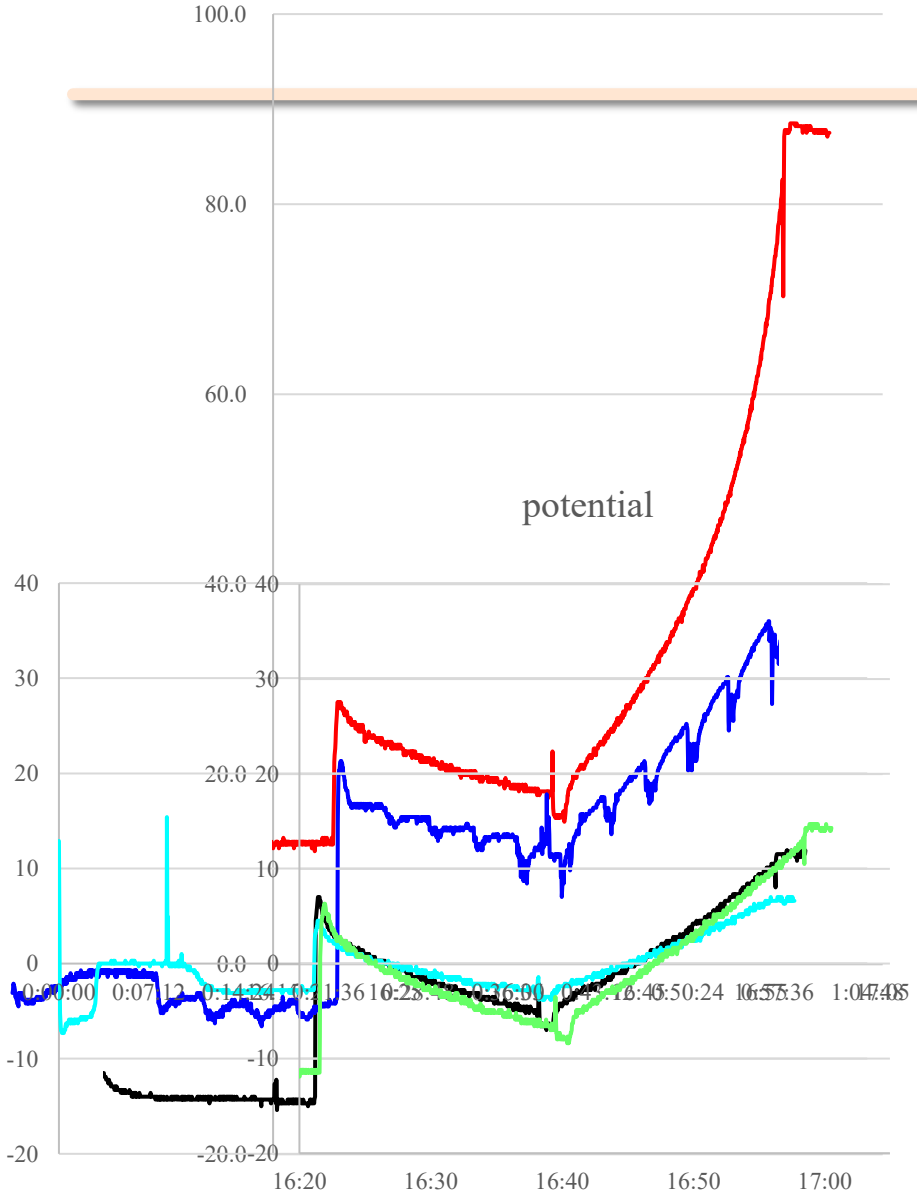
LNGS activity summary (Jul2025)



gel production EGS027

EGS027 1 batch / 6 washing (deionization) batches
wash 1-5 → Run film (1 large film ~ 100 g of washed gel)
wash 6 → quality evaluation at Japan

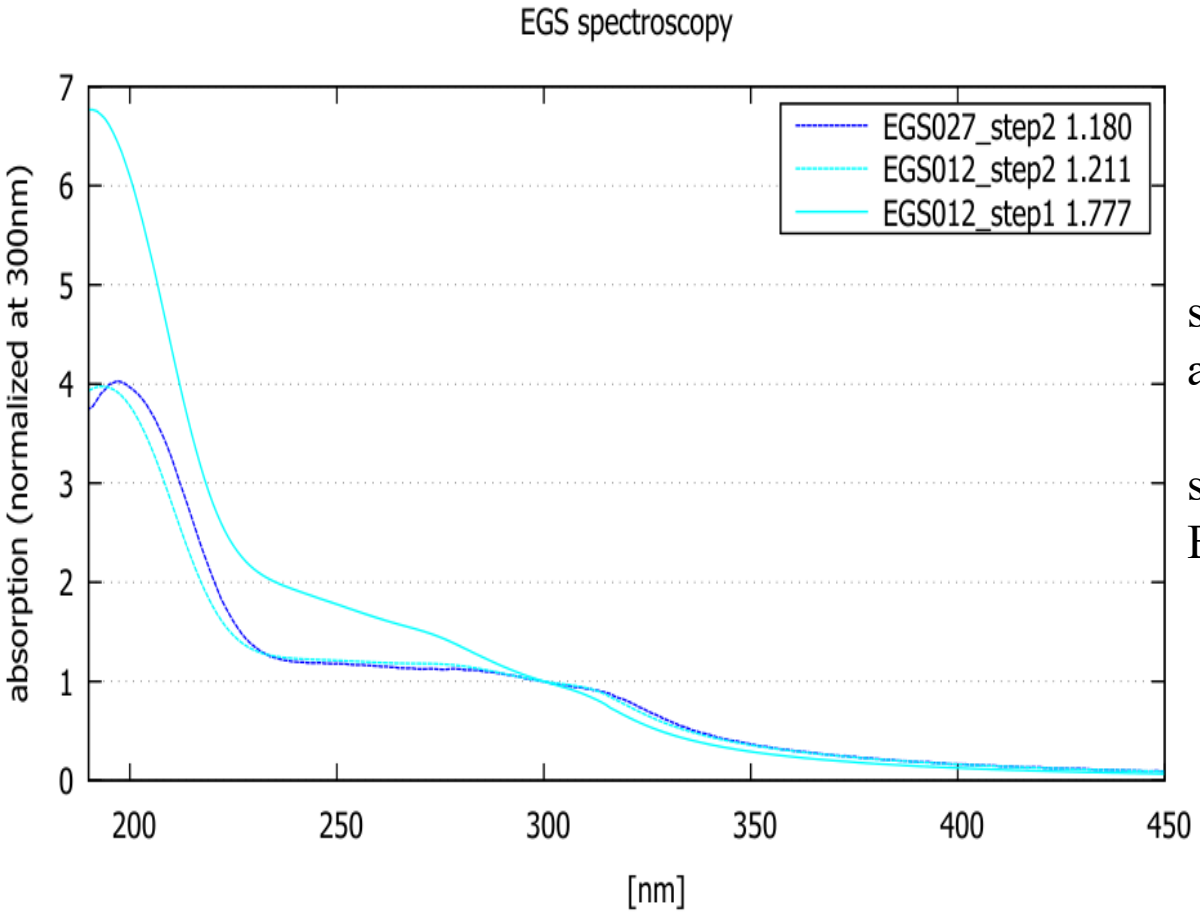
pAg result of produced batch



012
016 (electrical noise exist)
017
018
027 (this batch)

final pAg value goes high
offset was initially high. Sensor problem?

spectroscopy (crystal size check)

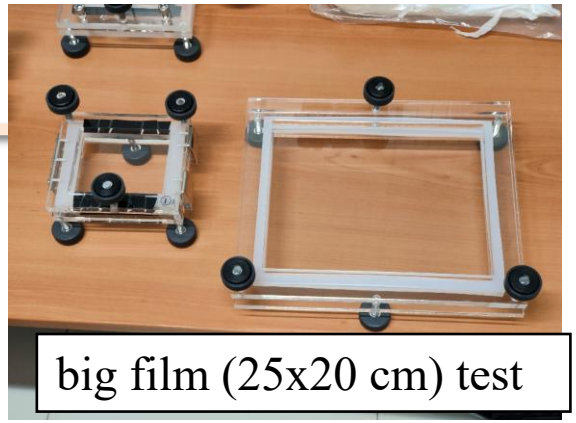


spectroscopy result of EGS027 is almost normal condition

step2 spectrum is consistent with EGS012 (70nm standard batch)

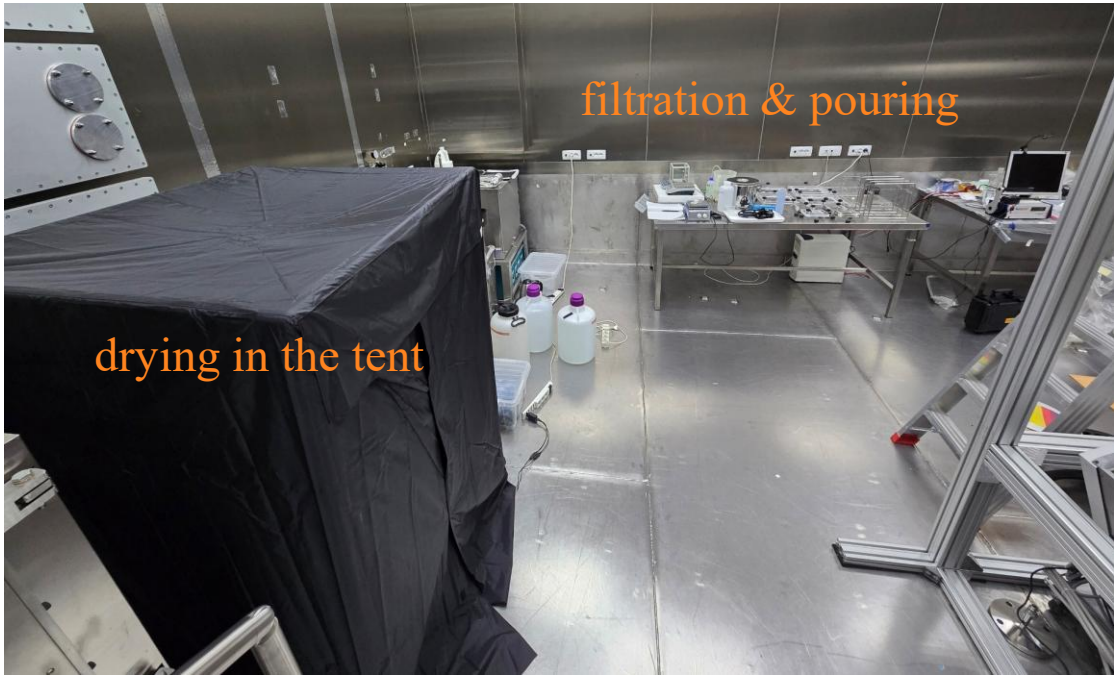
CR1 film production and large size film test

CR1 film production activity



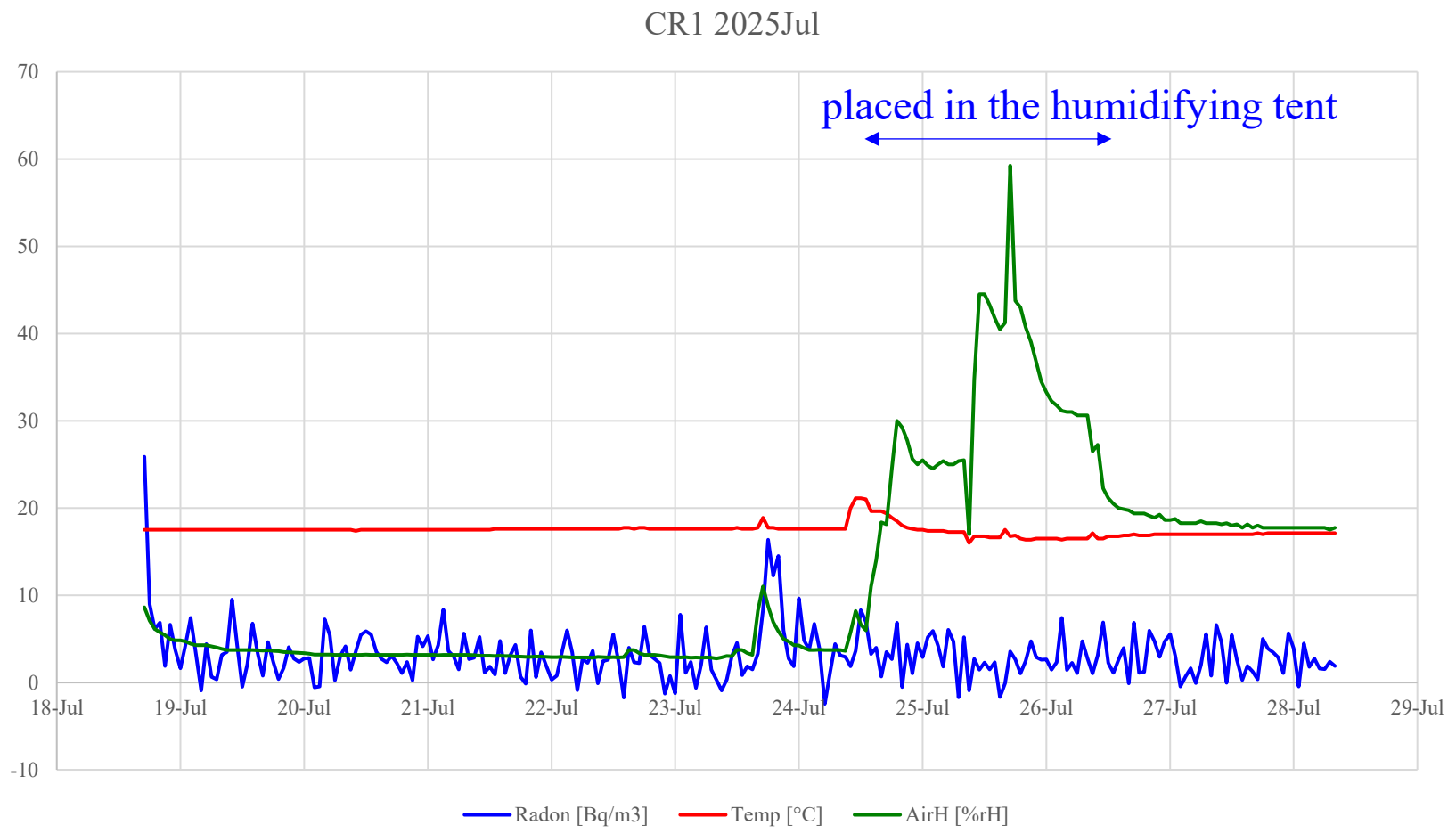
big film (25x20 cm) test

- electron is not main background this time. Radon and neutron are the background
- To reduce Radon, film production at CR1 is essential
- the humidity in the CR1 is near zero and cause problem of films→ humidifying tent test
- to increase target mass, sequential production of new size film (25x20cm) is tested
  - 90g × 4films:~360g + other size
  - filtration 20cc ＞20 times



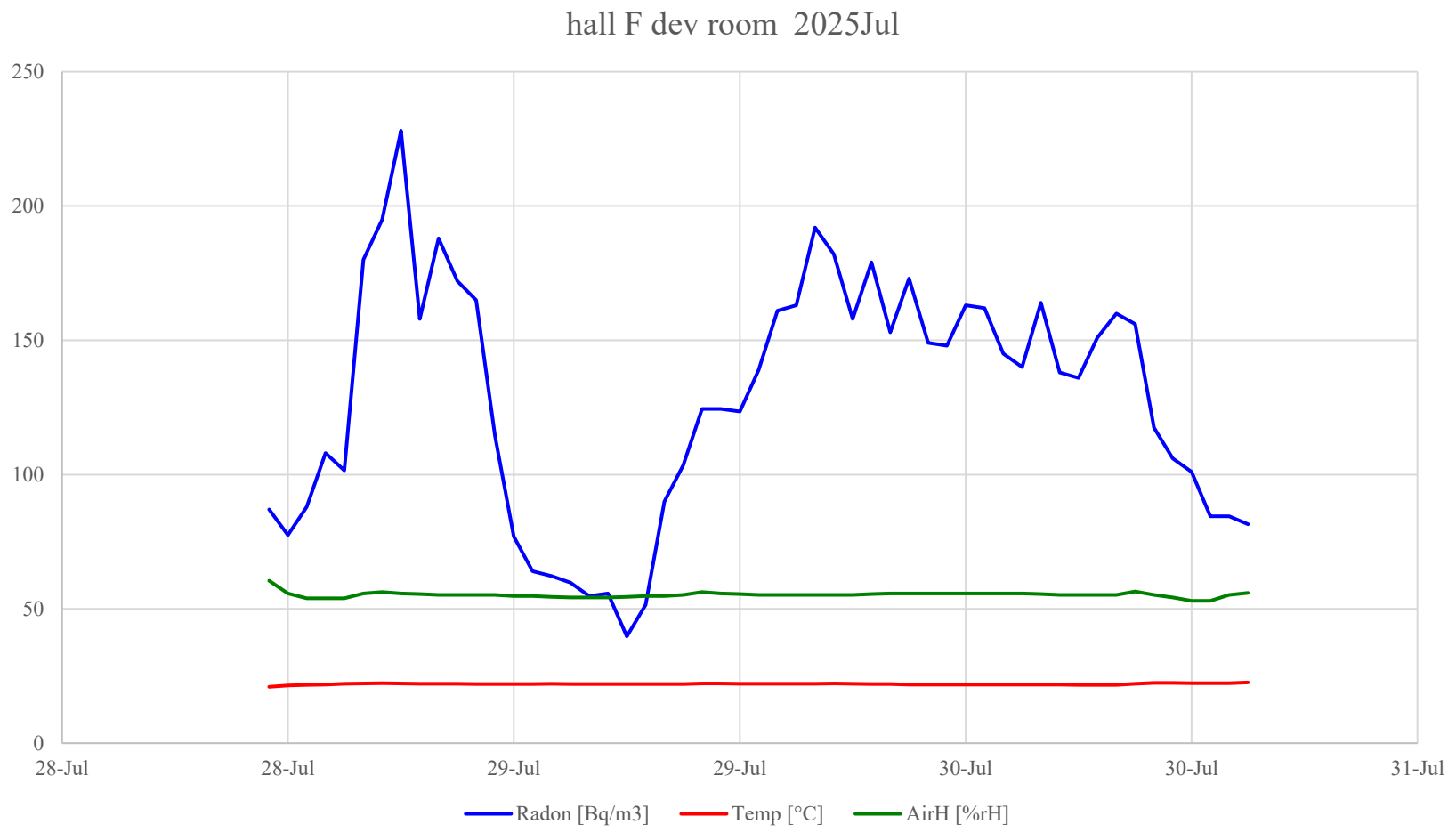
over dry problem

CR1 Radon monitoring

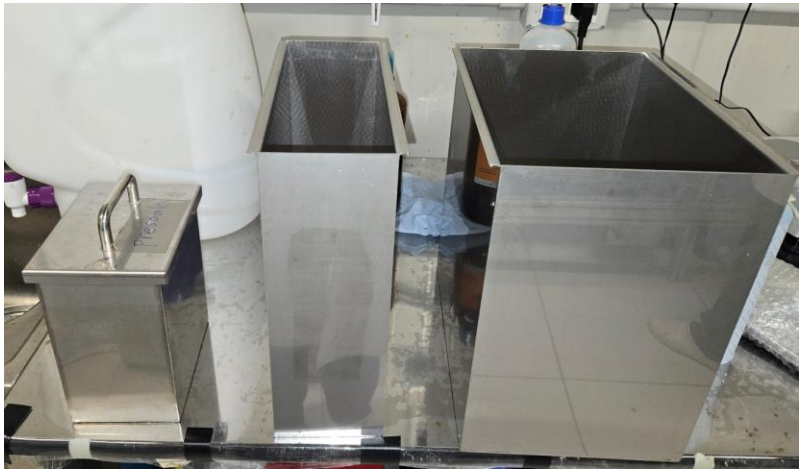


Properly humidified with a low radon level.

hall F

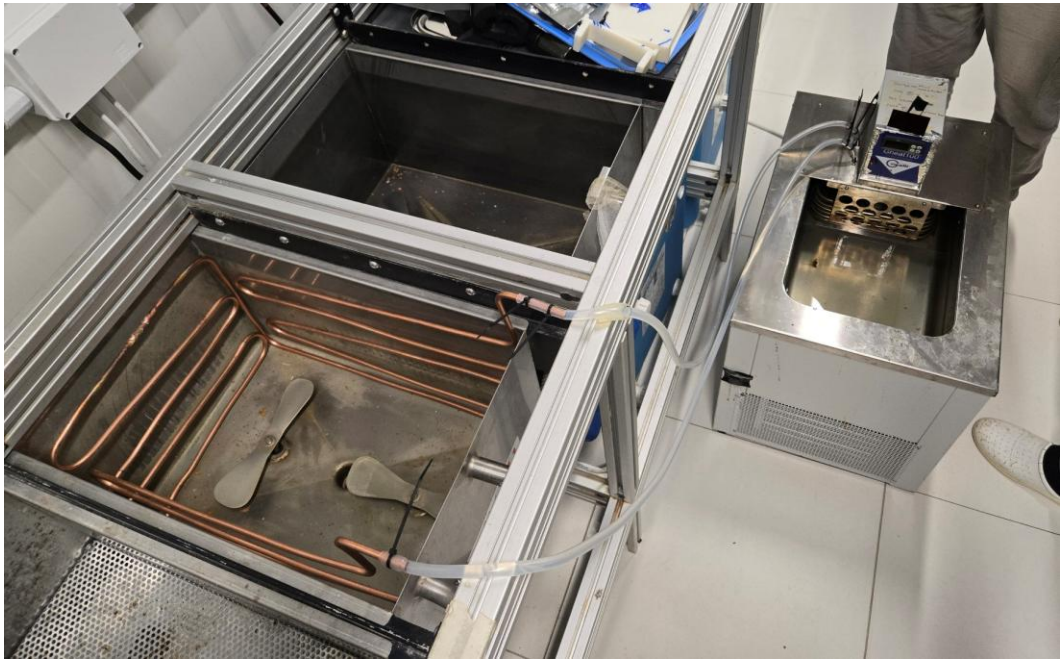

hall F dev room 2025Jul
250
200
150
100
50
0
28-Jul
28-Jul
29-Jul
29-Jul
30-Jul
30-Jul
31-Jul
Radon [Bq/m3]
Temp [°C]
AirH [%rH]

update of development setup in hall F



previous (2L)

new size (10L)



near future

new holder

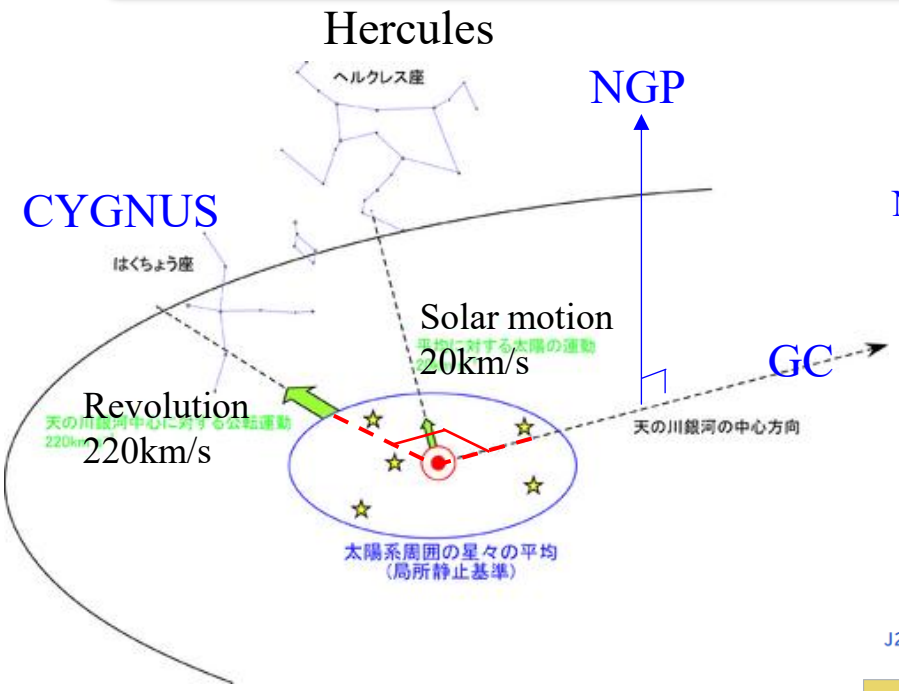
- big thermal bath for 10Lx4 tanks (in the future 20Lx4 tanks)
- cooled by outer thermal bath

problem

- temperature control (5.5deg aiming 5deg)
- floor is not stable
- update of antifreeze liq., insulation, water mixier etc. are needed.

exposure setup

Galactic coordinates and celestial coordinates



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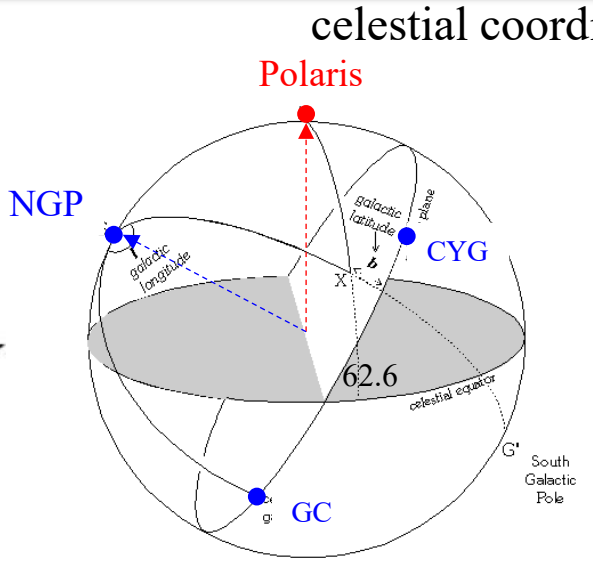
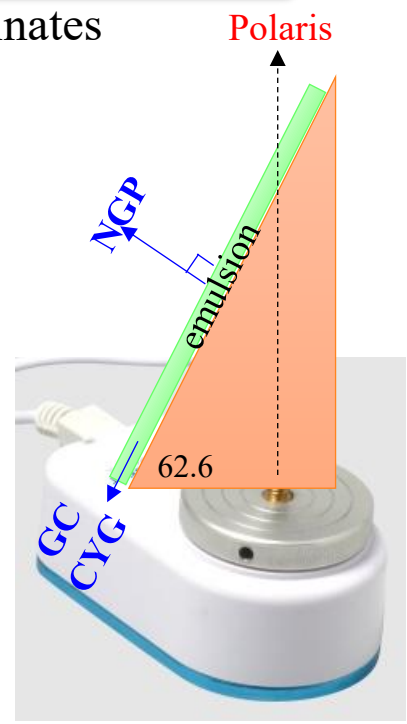




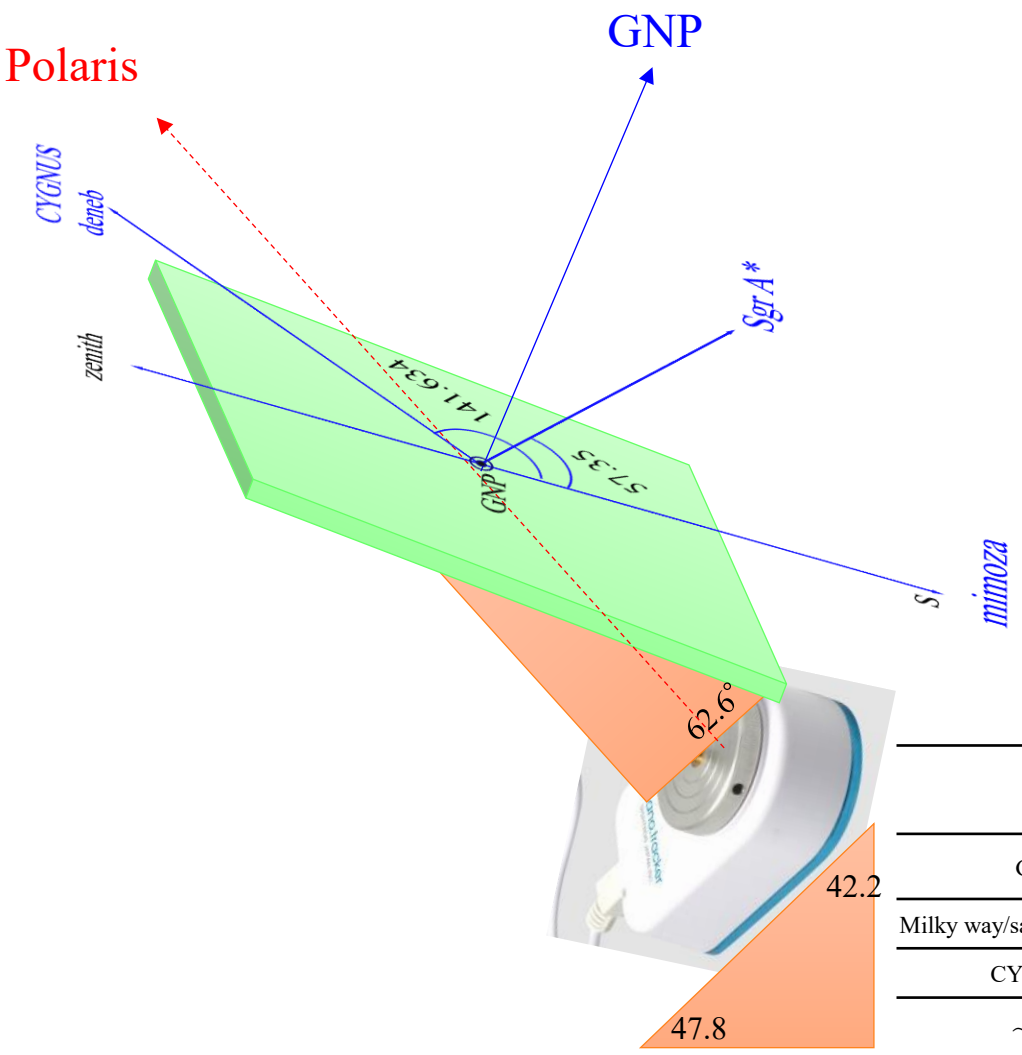
J2000.0 equatorial coordinates approximating the galactic reference points[1]

	Right ascension	Declination	Constellation
North Pole +90° latitude	$12^h\,51.4^m$	+27.13°	Coma Berenices (near 31 Com)
South Pole −90° latitude	$0^h\,51.4^m$	−27.13°	Sculptor (near NGC 288)
Center 0° longitude	$17^h\,45.6^m$	−28.94°	Sagittarius (in Sagittarius A)
Anticenter 180° longitude	$5^h\,45.6^m$	+28.94°	Auriga (near HIP 27180)

Galactic **N**orth **P**ole (GNP): 31 Com (Coma Berenices)
Galactic **C**enter (GC)： Sgr A* (Sagittarius)

The simplest setting: Setting emulsion at 62.6 deg from north celestial pole
→ GC and CYGNUS will be both on the emulsion plane

Exposure set up

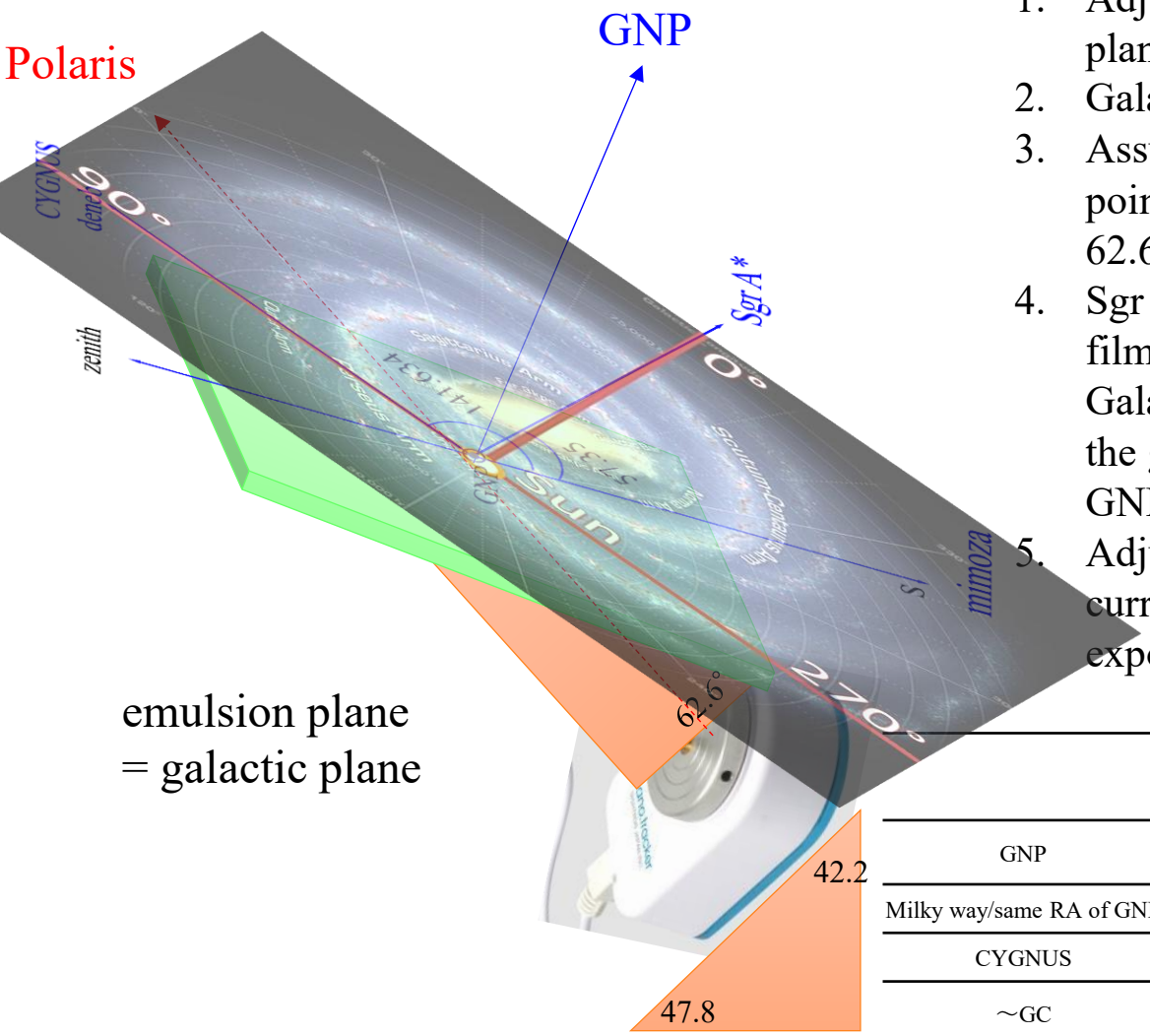


procedure

1. Adjust mount axis to Polaris (axis = latitude, plane = 90- latitude)
2. Galactic plane is 62.6° from celestial plane
3. Assuming that the GNP is directly overhead, point the film toward true south with angle of 62.6 + 42.2 (left figure)
4. Sgr A* and deneb(CYGNUS) will be on the film and angle can be calculated from Galactic Longitude *l* using mimosa (also in the galactic plane and same RA of GNP=placed to the south at setting)
5. Adjust film RA from GNP overhead time to current time by high-speed rotation and start exposure

	star	RA	Deg	l	b	l angle from mimoza
GNP	31 comae berenices	193.2	27.4	306.1	90.0	4.0
Milky way/same RA of GNP	mimosa	192.3	-59.8	302.7	3.0	
CYGNUS	deneb	310.4	45.3	84.3	2.0	141.6
~GC	Sagitarius A*	266.4	-28.9	0.0	0.0	57.4

Exposure set up



emulsion plane
= galactic plane

procedure

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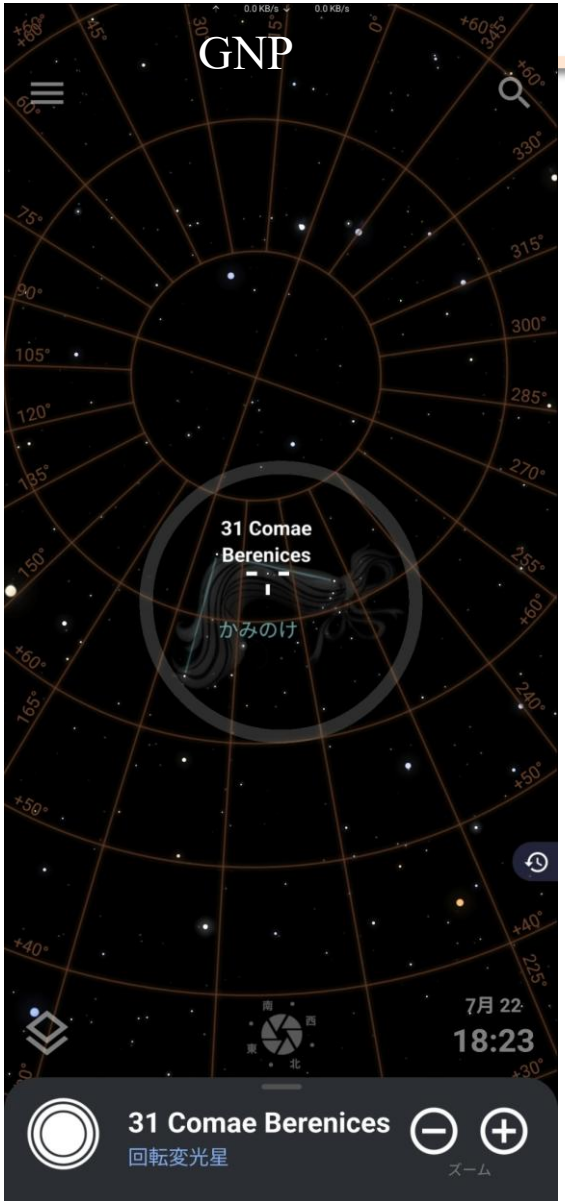
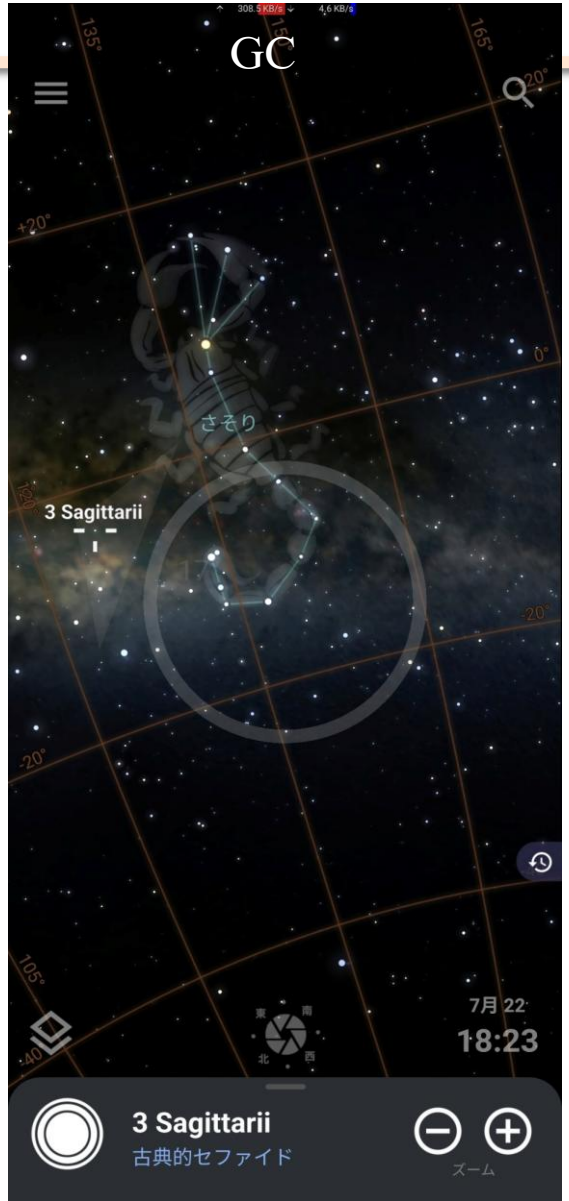
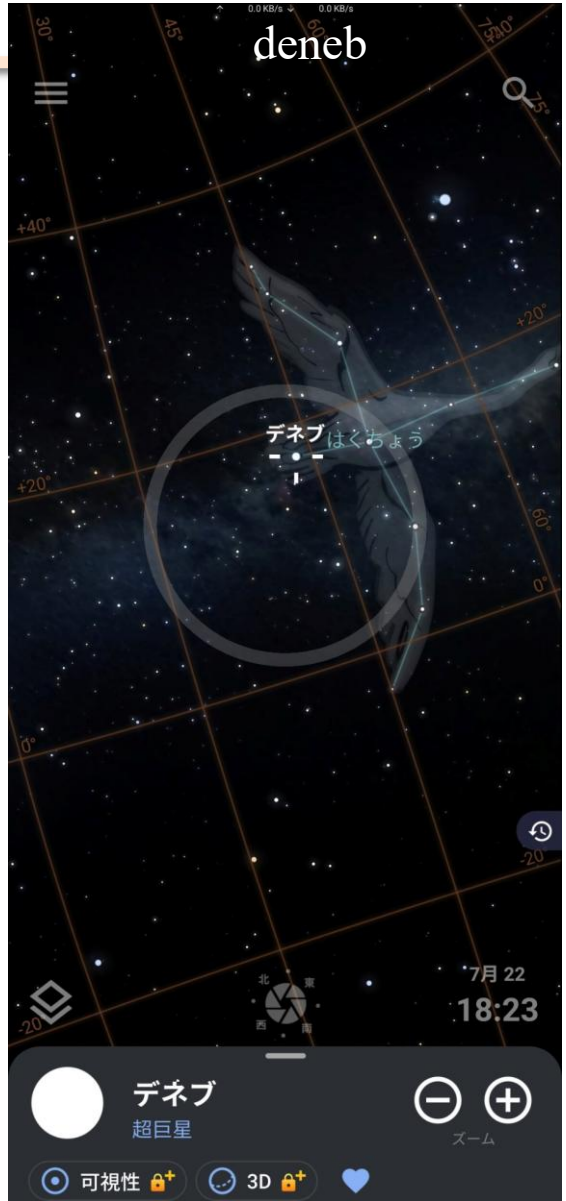
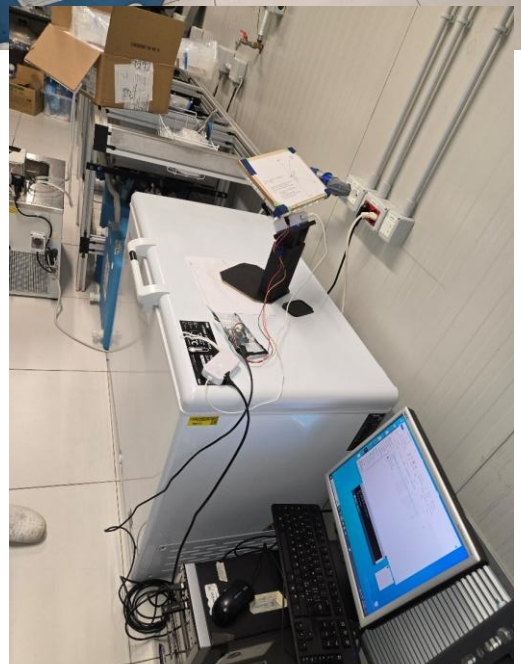
pre-check of setting method by app

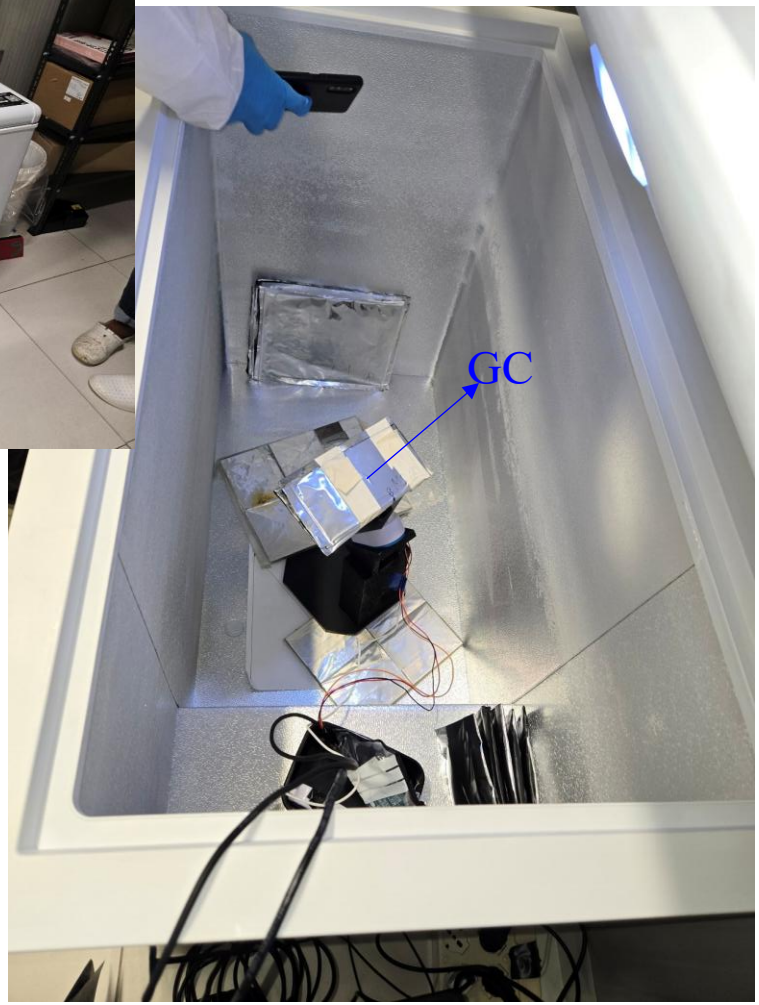


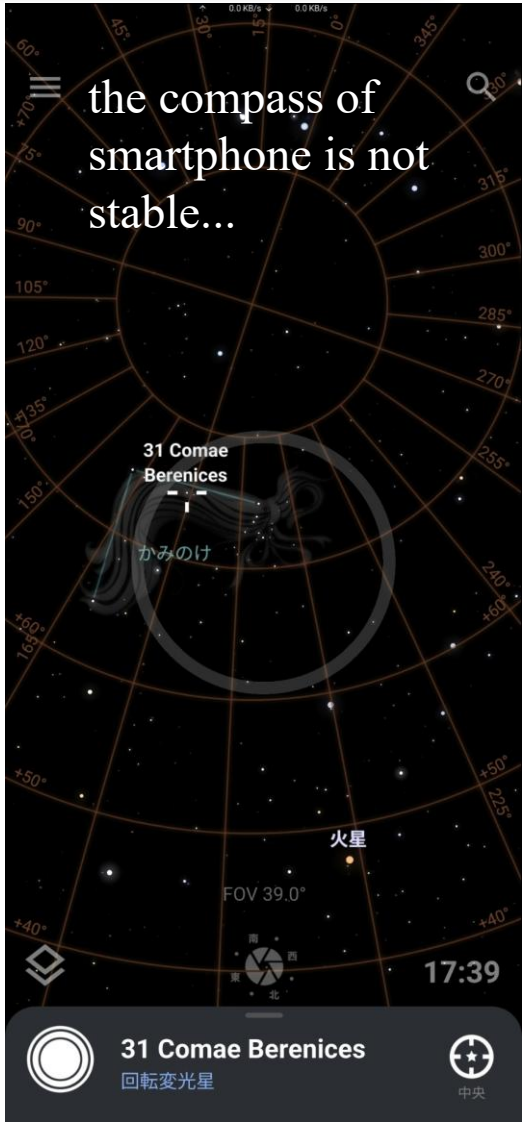




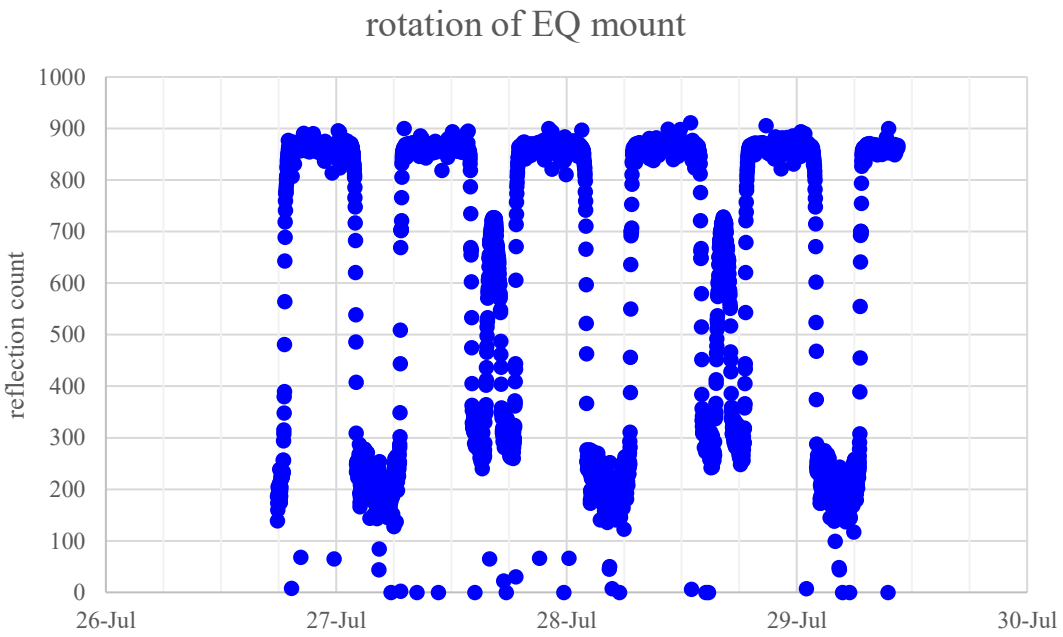
check at the exposure start







rotation monitoring

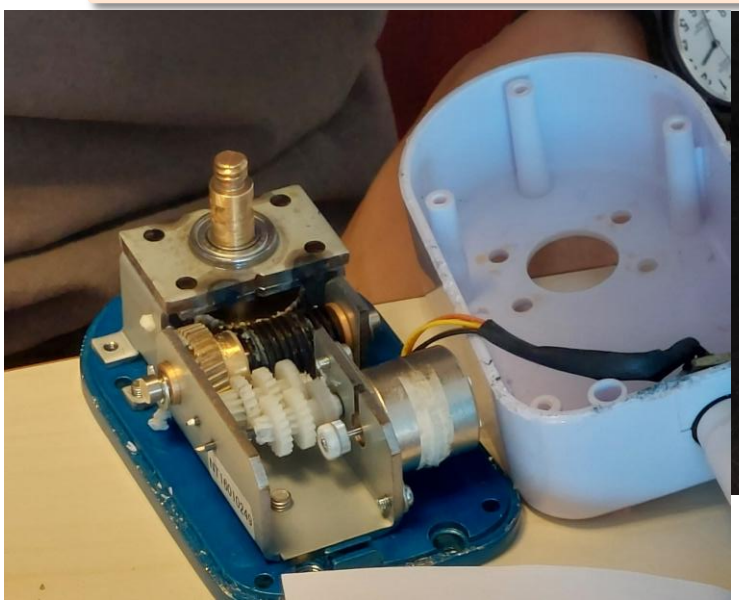


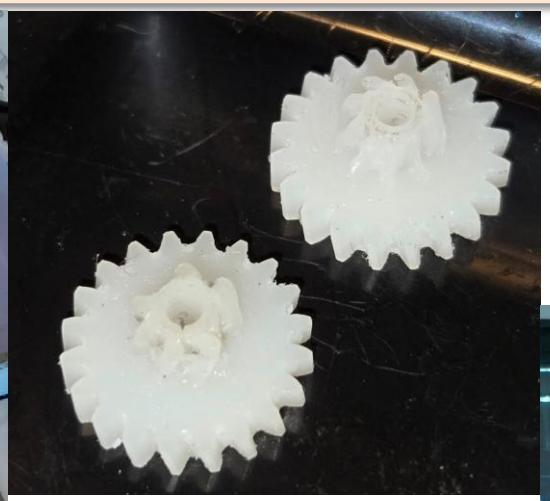
Monitoring the rotation condition with photo diode and reflection mirror
Daily pattern successfully continues

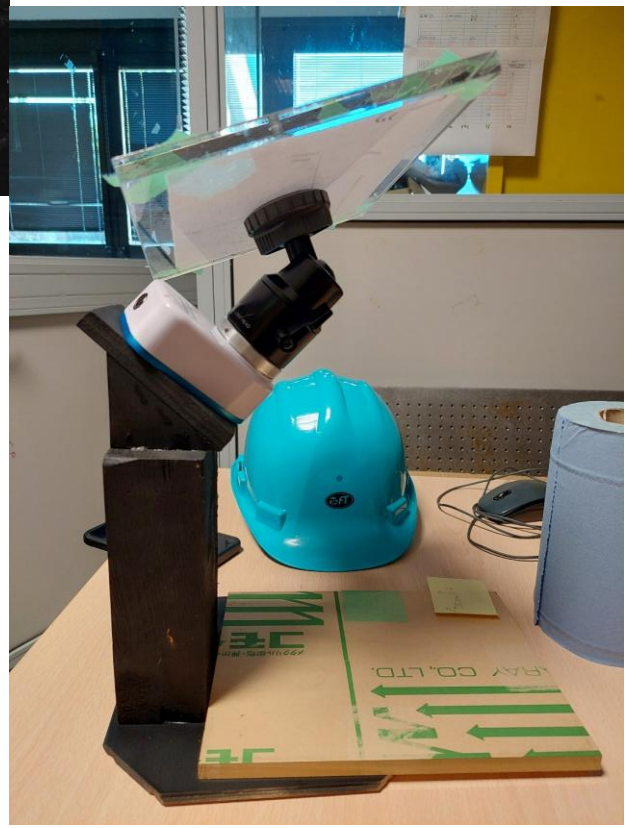
→ 2-4 month Run is expected
(mass~2g/film → ~200g·days in max)

problem and task for further update

The gears of the Equatorial Mount were damaged







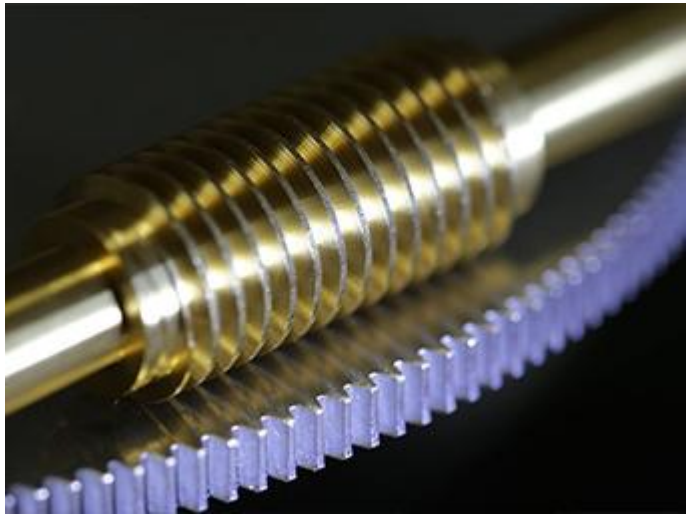
nano.tracker

- payload speck: 2kg × 10cm from axis
- film(demo) ~1kg (~200g × 4 film is expected)

problem of barycenter?

→ We decided to use normal size film (~30g) for the run

gear update plan



SWAT-350 series

- 100k~200k yen
- table payload ~15kg
- gear: duralumin + brass screw?
- high speed mode: max 16x (nano.tracker: 50x)

→ worst case, 45min needed for start time adjustment?

filtration update

Approximately 60 repetitions are needed for a 100g mass scale.
Operation at a high temperature of 85 degrees.

- We Should use a pressure filtration system

We will discuss with the company (ADVANTEC) in August.

CR1 problem and update

- There is no direct demi-water supply, and the demi-water waste line is also unavailable.
- The N_2 gas line is shut off. (not been disconnected yet?)
- Desk space is nearly occupied by four large pouring stages.
- big shield is needed for CDM run scale up
- What is the expected availability of CR1 going forward?

situation of scale up

- Next scale
  - 20 × 25 cm film (emulsion area: 18 × 23cm)
  - 1 film weight ~100g, target mass ~10g at 40um both sides
  - -10 films (100g mass scale) ·10day = 1kg·day as a goal of this step
  - target mass of this trial is 4 films ~ 40g
- Production
  - dry mass -100g/batch→ 1-2 production is enough
- Deionization
  - Same method is still acceptable (about **5 times of 1.5L scale washing → 1 day** for complete)
  - (Scale-up is also possible (simply increase bottle size from 2L to 10 L) (new bottle is needed))
- Pouring
  - Filtration can be a problem (cylinder capacity -30mL→ about 4 times/film, 40 times for 1kg·day)
    - Same method is hard but still possible for next demo. However, machine filtration should be applied
    - Additional pouring stage is needed → 4 stages pouring are tested / desk space can be next problem
  - Humidity control at CR1 (box or booth) → humidifying tent works well/CR1 equipment and space is not enough
- Exposure
  - Upgrade of equatorial mount → nano.tracker(payload 2kg) didn't work well, update is needed
  - Upgrade of shielding → difficult for short term. Demo will be done without shielding.
  - Upgrade of freezer → new big freezer is applied and operated well in -25deg
- Development
  - New scale tank (7L) and holder for 25 × 20cm → Ready
  - Chemical preparation for 7L scale → stainless pot works well. big and dustless magnetic vibrator is needed
  - New development bath for 8L, 16L, 32L- scale → OPERA dev chain is updated, but needs further update. 7L could fit to inner thermal bath