Status report of Nagoya

Tatsuhiro Naka
Nagoya Univeristy

Dec. 12th, 2016 @ University of Napoli

Dust reduction study

Test of dust contamination using gelatin

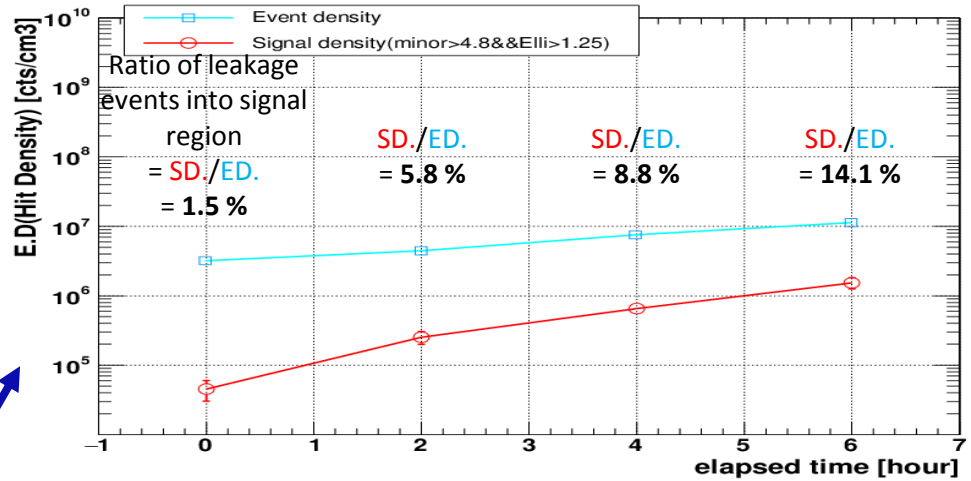
	Cover	Rotation	BG for 0 hours	BG for 6 hours	Room condition
1	no	yes	~ 5E+4	~ 1.5E+6	Normal
2	yes	yes	~ 2E+5	~ 1E+6	Normal
3	yes	no	~ 3E+5	~1.5E+5	Normal

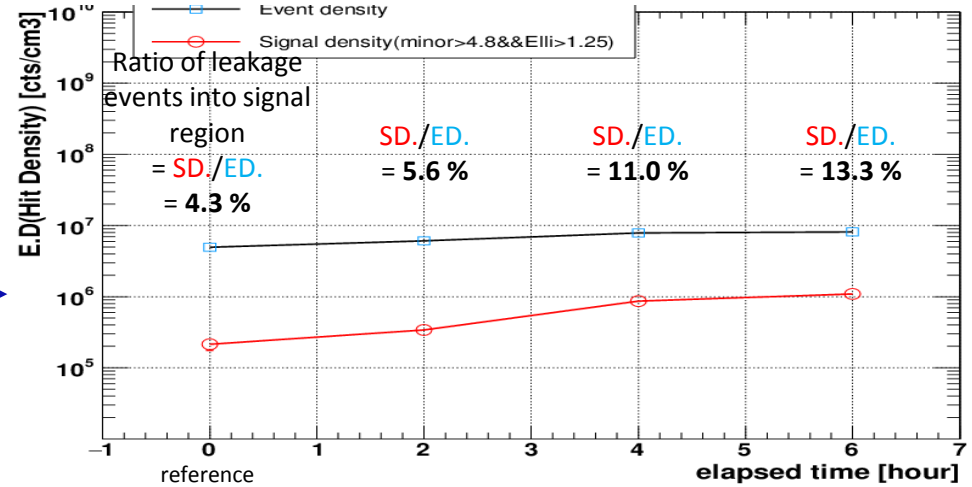
Cause of increasing :

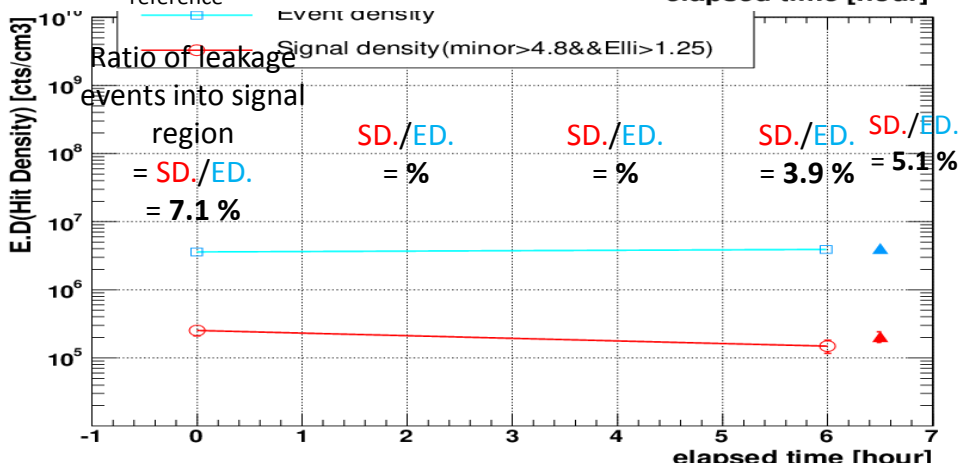
1 : contamination from air or material (beaker, stealer) by rotation using stealer

2 : silent condition was not rise up the dust.

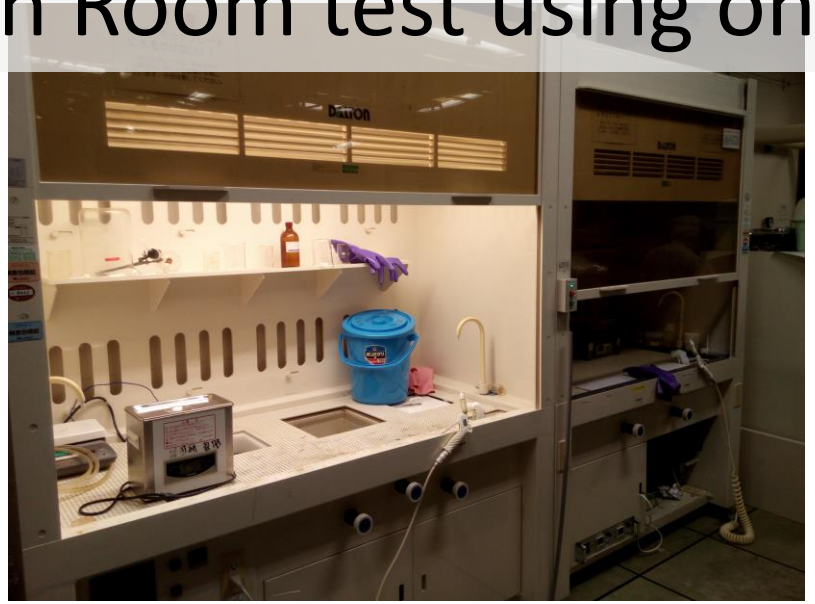
Initial value (always ~1 x 10^5 /cm^3):
what is it limited by? ⇒ e.g., dust in air

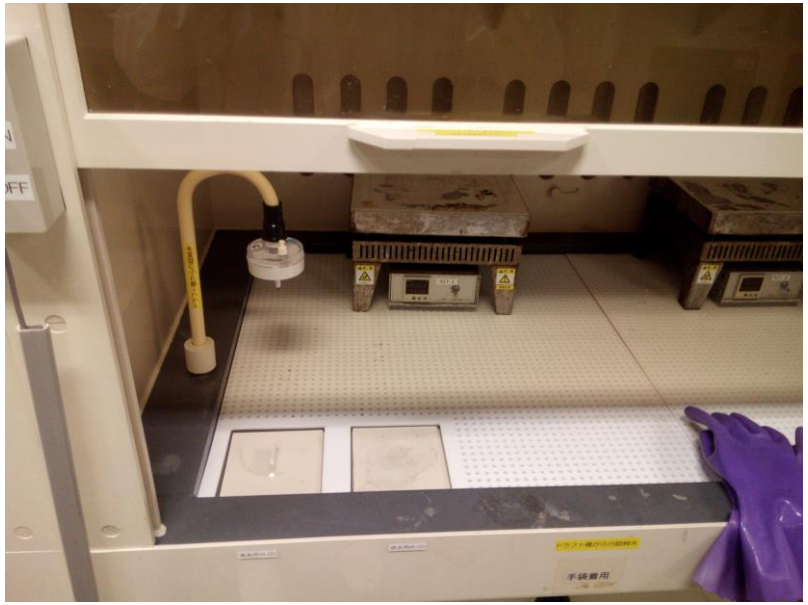






Clean Room test using only gelatin@ Nagoya University





Sample making

- Clean room: ISO class 4 (10^4 particles/m^3 for > 0.1 µm)
- Gelatin : pure gelatin (high de-ionized gelatin)
- Filter : 0.1 µm membrane filter
- All process was done in clean room
- Used Water : ultra-pure water
- Used material : not special, but washed by water + ultrasonic in normal room and by super-pure water in clean room.

	Sam.1	Sam.3	Sam.5
Scan area	0.00027 cm^3	0.00039 cm^3	0.00043 cm^3
Signal like event	**4**	**2**	**8**
Not signal like	5	5	14
Sphere event leak	5	6	11
Pouring Condition	Clean room	Normal room	after 4 hours keeping at normal room
Total [/cm^3]	5 x 10^4	5 x 10^4	8 x 10^4
Signal like as ellipse [/cm^3]	1.4 x 10^4	5 x 10^3	1.9 x 10^4

✓ Making in clean room
✓ ultra-pure water
✓ pouring is in clean room

✓ pouring the sample.1 in usual room

✓ 4 hours put sam.3 in usual room

- **At least, We updated one order, and it achieved the lowest dust level for gelatin.**

⇒ **probably, this is due to clean room handling.**

- **we have to understand more source**

1. other contamination from the materials we are using
2. coming from filter itself (?)

Summary and plan

- We could get the clean room environment and ultra pure-waterto handle the gelatin (but, not so large space).
- Rotation at normal room is critical cause to increase the dust

- Some contamination from material itself (beaker, stealer, filter etc) is one of the possibility, therefore we should check it.

(it is possible to separate between material and air by doing in clean room)

- At least, we require the clean room to handle the emulsion gel. Include the production.

⇒now we are trying to get the fund to construct the new production machine to install in LNGS.

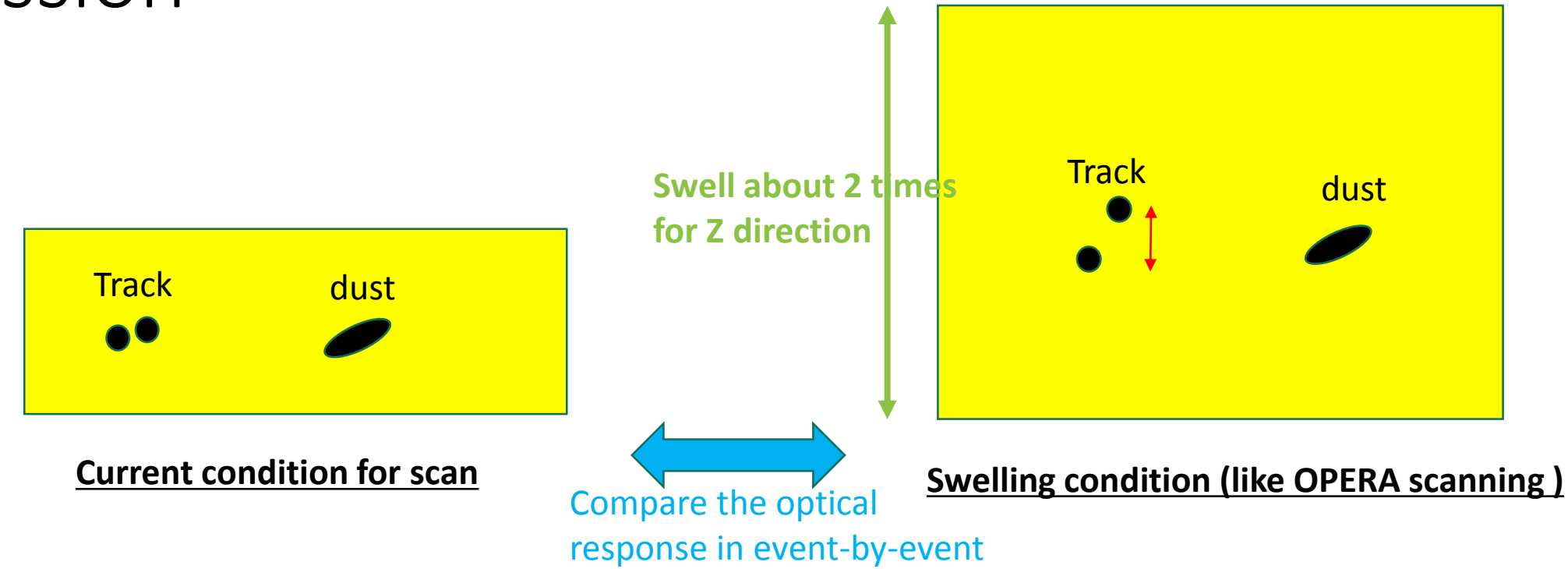
Example for future


Example from web.

- All process should be done the process from production to pouring in clean room
- It's the best to make such facility in underground.
- As high cost materials, production machine and clean room itself are considered.

⇒ we need to get the fund for that.

Discussion



- **We already know the tracks are elongated by swelling. (*e.g., T. Naka et al., Nucl. Inst. Meth. A Vol. 581, (2007) 3*)**
- **If dust has only one cluster, it should not be elongated.**
- **If we can take output as some optical response, we should be able to discriminate the tracks from the dusts.**
- **For example, standard swelling process like OPERA is easy, stable and with scalability.**

Electron sensitivity study

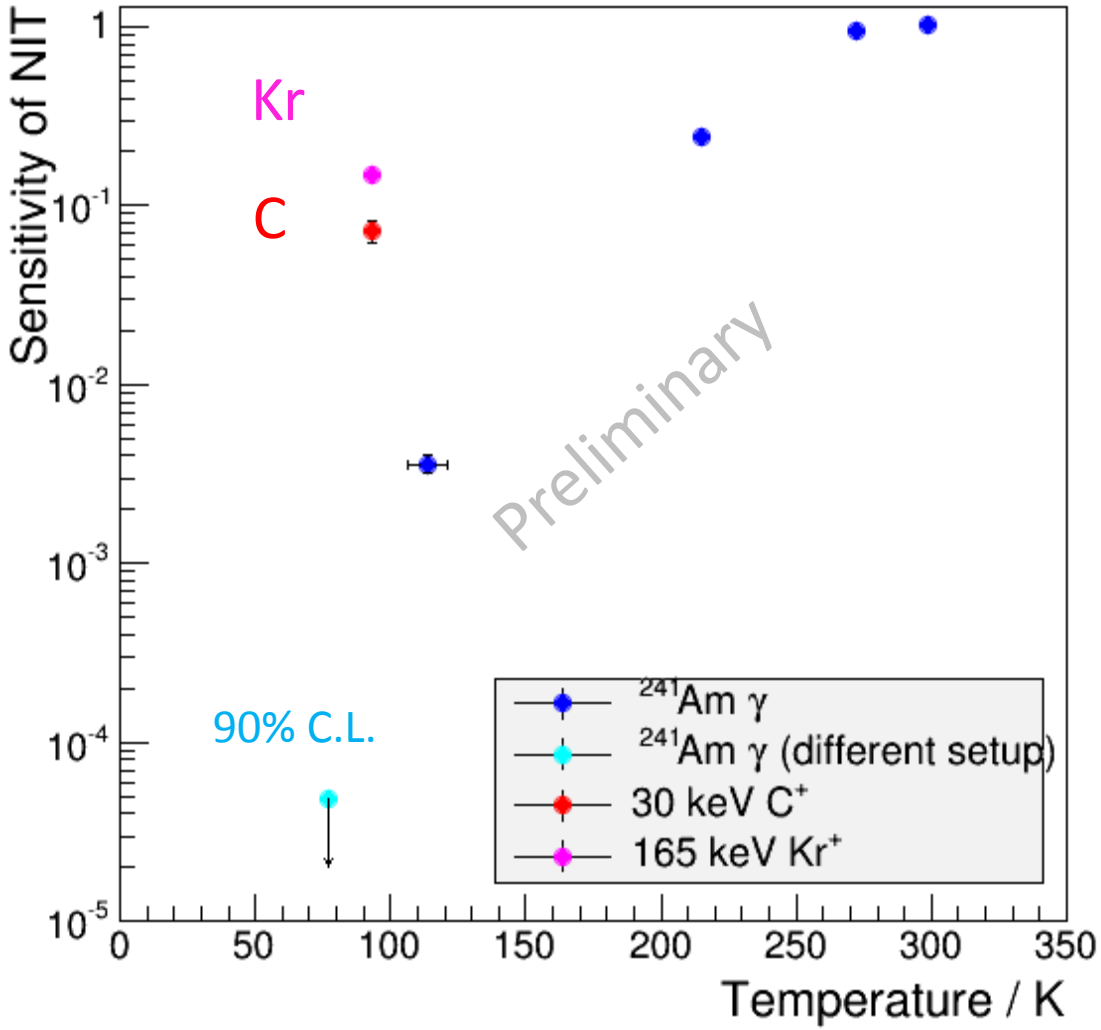
Now on progress, but as plan,

1. Response check (i.e., leakage event rate for β-rays) for each sample treated some chemical techniques.
2. Temperature dependence ⇒ we need to discuss more how to do that. (e.g., using emission from the chemical like KBr)
3. Sensitivity check combined temperature and chemical treatment
4. Nuclear recoil calibration with same condition, but we need to discuss how we can do that.

Analysis for β-ray

1. 1st step will be utilized standard selection using elliptical fitting.
2. As next step, some data analysis using the Plasmonic reaction, because we can expect the structure of Ag filament should be changed.

Temperature dependence on the sensitivity for current NIT device



- S/N (NR /electrons) is increase in lower temperature.
  ⇒ Dependence of energy loss mechanism

Nuclear recoil : thermal spike in the AgBr crystal due to nuclear stopping power and high electron stopping power
Electrons: only ionization and low dE/dx

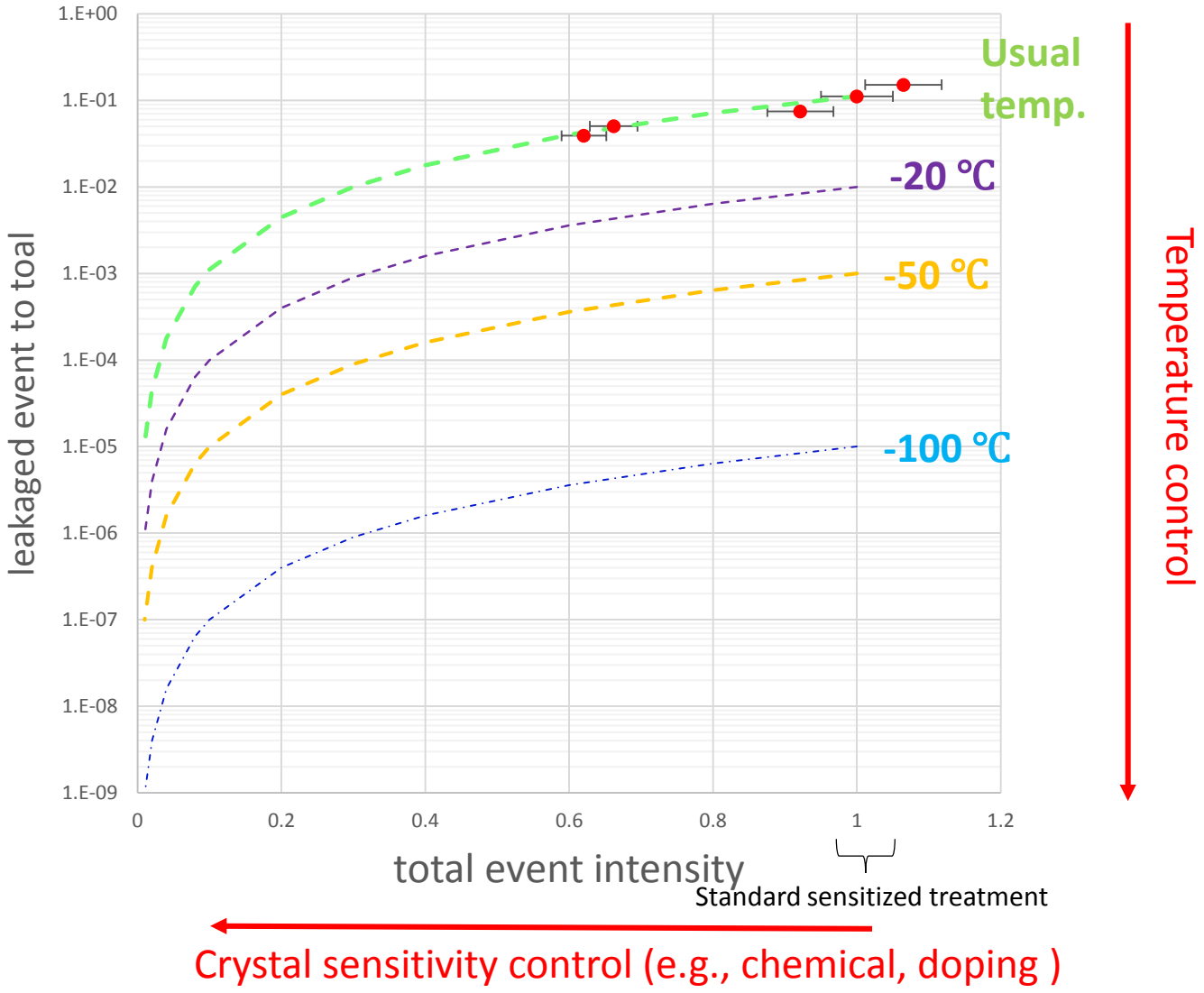
- Cryogenic condition is critical for electron background rejection .

- In addition, stability for emulsion device should be improved.

M. Kimura *et al., NIMA (VCI2016) 2016*

Background rejection expectation

Electron background rejection power using only elliptical analysis



Status of Synthetic polymer

Dr. Tani found the promising candidate from the Japanese old patent of “Mitsubishi Paper Mills Lmited Co.”

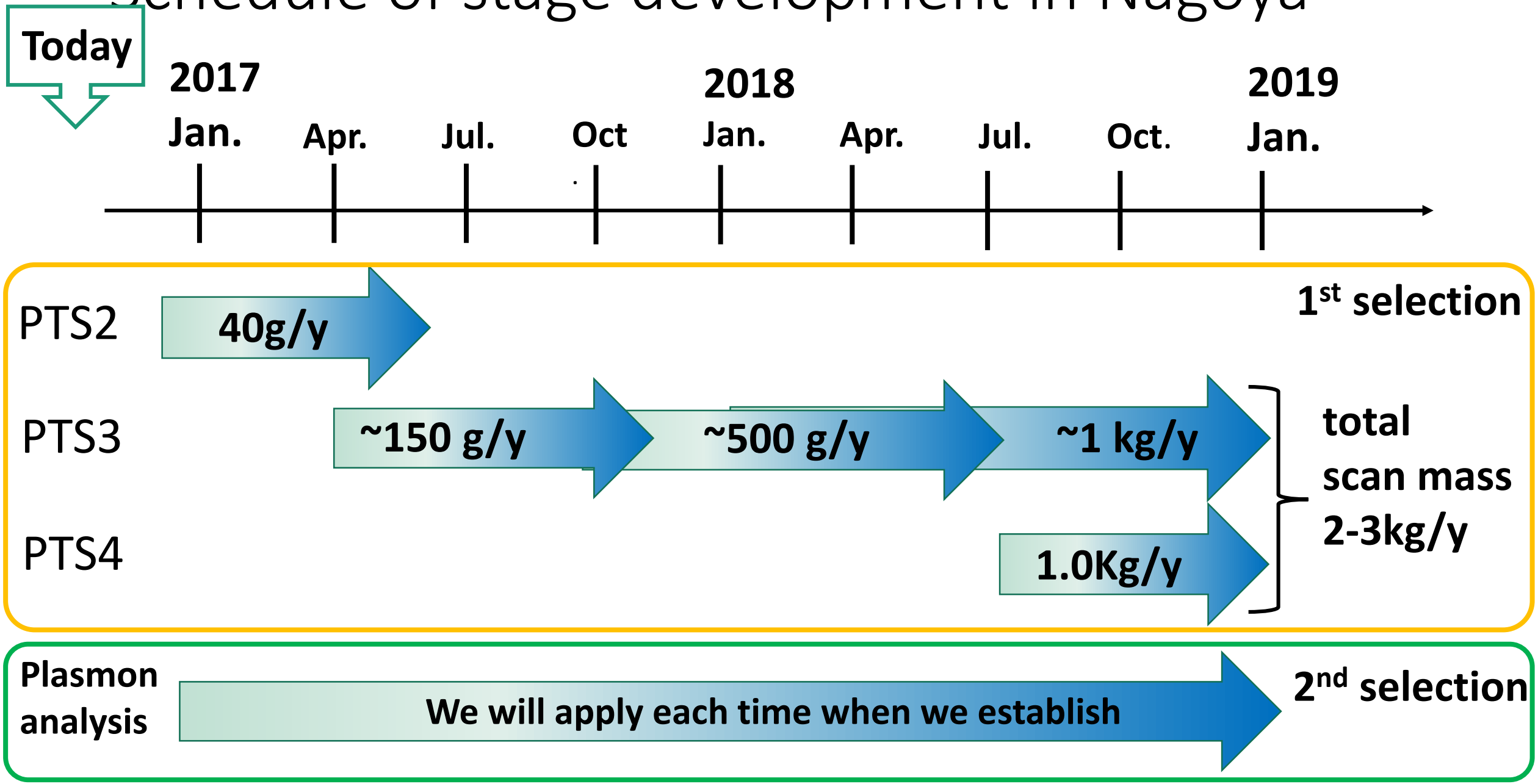
Required chemical :

Name of required chemical	Current situation
PVA	already have
Styrene maleic anhydride (Mw ~ 8 x 10^4 in the patent)	Found the company ⇒ now asking the cost (Mw ~ 2 x 10^4)
Isobutylene maleic anhydride (Mw ~ 6 x 10^4 in the patent)	Found the company to get ⇒ ordered 100 g sample (Mw ~ 5 x 104)
NaOH	Already have
Styrene formamide	Already ordered ⇒ should be get in a week

✓ In this month, I will be able to have all materials and start to test produce according to the patent

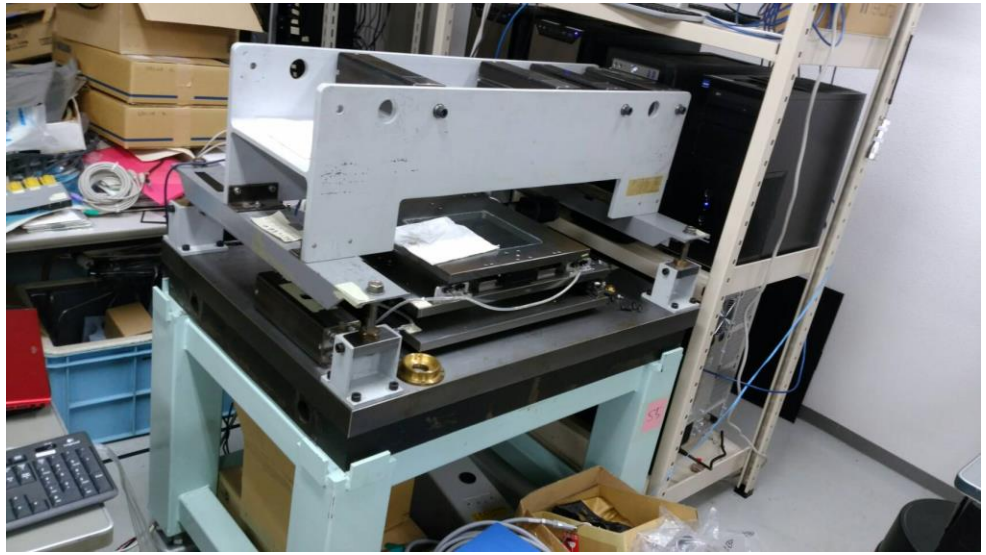
Report for Construction of PTS3

Schedule of stage development in Nagoya



Comparison

	PTS2	PTS3
Camera	4Mpixel 180fps	12Mpixel 180fps
FOV	110um × 110um	187um × 140um (have a possibility of change)
DOF	±0.3um	±0.3um
Frequency	1Hz	1Hz
Speed[g/day]	0.19	0.56
Speed[kg/year]	0.047	0.141



PTS3(under construction)

- ✔ lower magnification + large number of pixel
- ✔ simultaneous image taking for different depth by several camera
- ✔ Deep DOF customized lens

step-by-step install

Toward several kg /y by various techniques

Additional plan of optical system

Multi wavelength analysis and Polarization analysis may be able to be attach to PTS3.

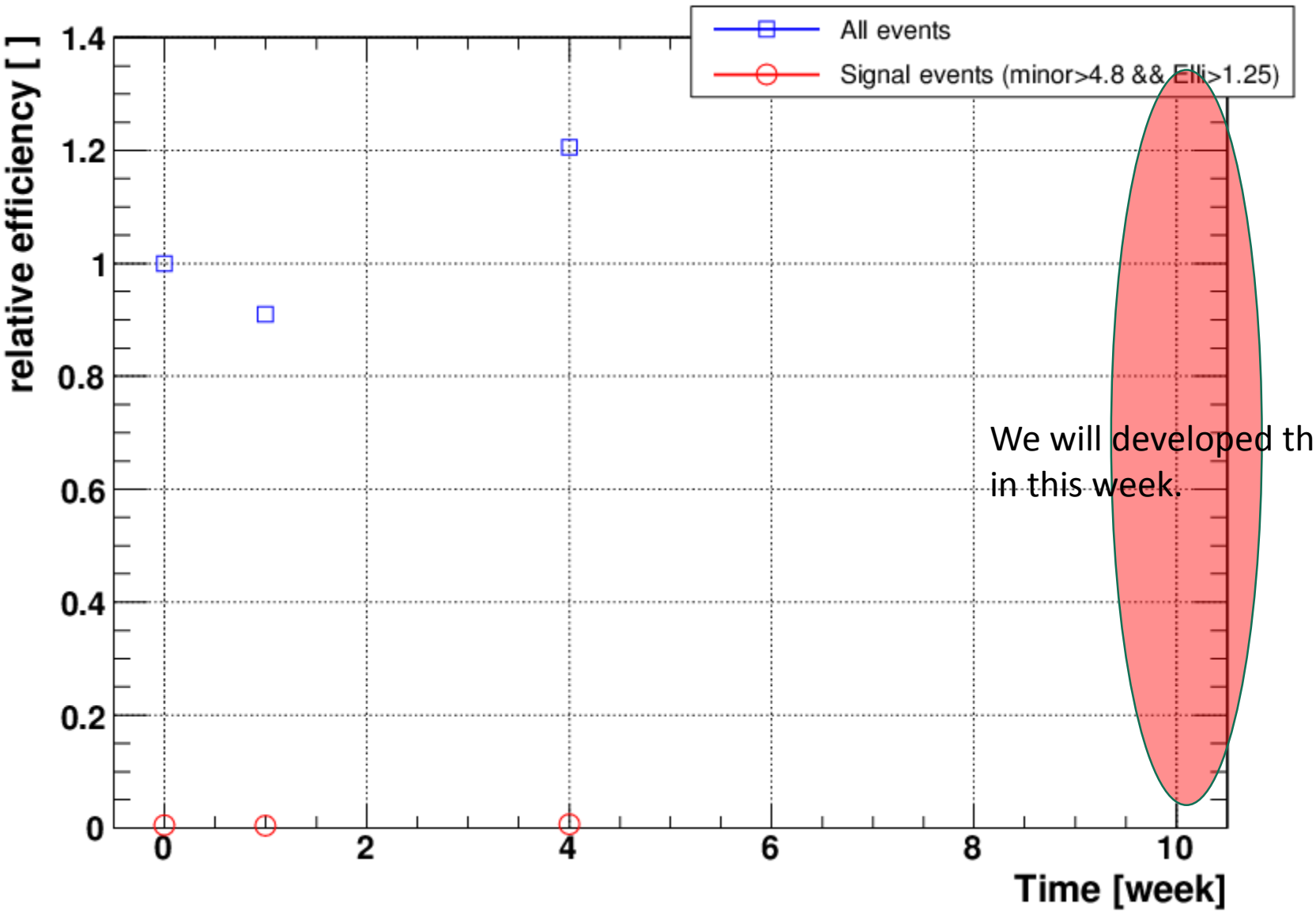
Summary

- We started to study about contamination of dust in clean room
- Electron background study is on going, and it will be reported at next NEWS meeting (end of Feb. or big. of March ?)
- We found the company to get required chemical for synthetic polymer, and those will come in this year. ⇒ start the R&D
- construction of PTS3 is started by Kobayashi and Yoshimoto.

Other status :

- ☑ Study using PTS2 is on going such as cross-check with Napoli's system and data sharing
- ☑ Difference of signal as latent image specks between electron and nuclear recoil (or alpha-rays) is studied by Tada.

Fading (LNGS sample) preliminary



We will developed the sample in this week.