

Toward First Light of NINJA: My experience of “Development”

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NINJA team

Outline

1. What is NINJA?
2. My Development Experiences
3. My current & future researches
4. Summary

What is NINJA?

Near-**I**nfrared and optical **J**oint spectrograph with **A**daptive optics

- **PI**-type spectrograph optimized for **L**aser **T**omography **A**daptive **O**ptics (**LTAO**) (JSPS KAKENHI, PI: Yoshida)

Red-NINJA

Blue-NINJA

- **high sensitivity**
- **conceptual design phase**
- $J_{AB} = 22 \text{ mag}$ (2-hr, S/N=10, R=4800)
- **wide wavelength (0.85-2.5 μm)**

3 Graduate students join NINJA

Riku Sato (Waseda Univ, D2)

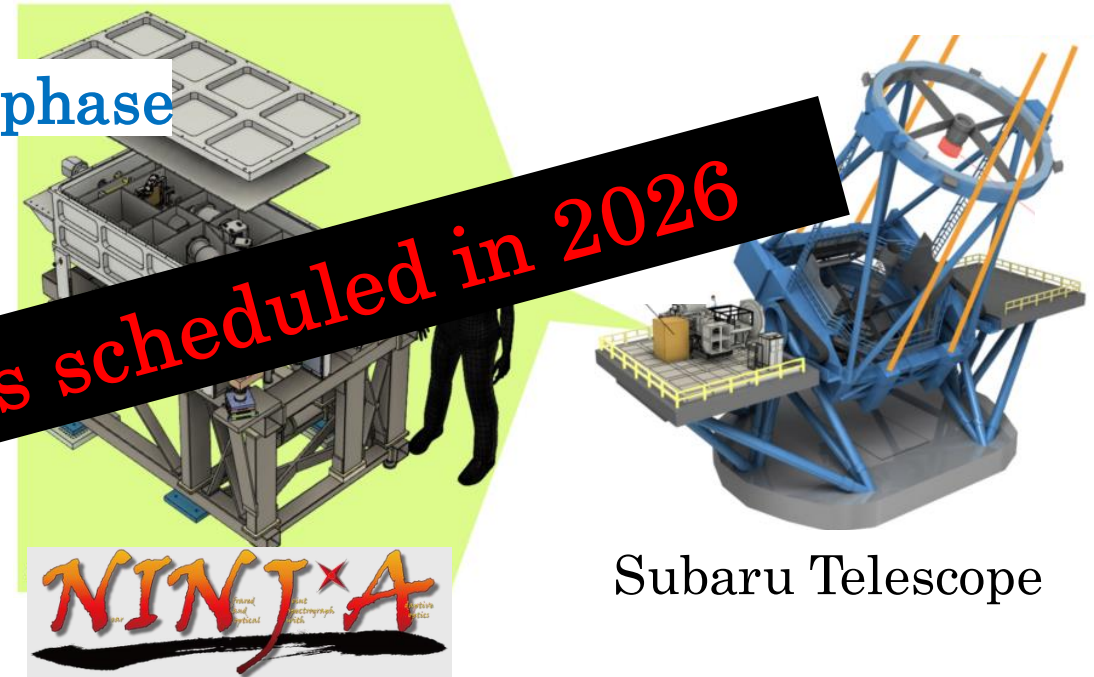
- Motor control and
- NINJA system

Tomoya (Univ of Tokyo, D2)

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Kensho Tanaka (Univ of Tokyo, D1)

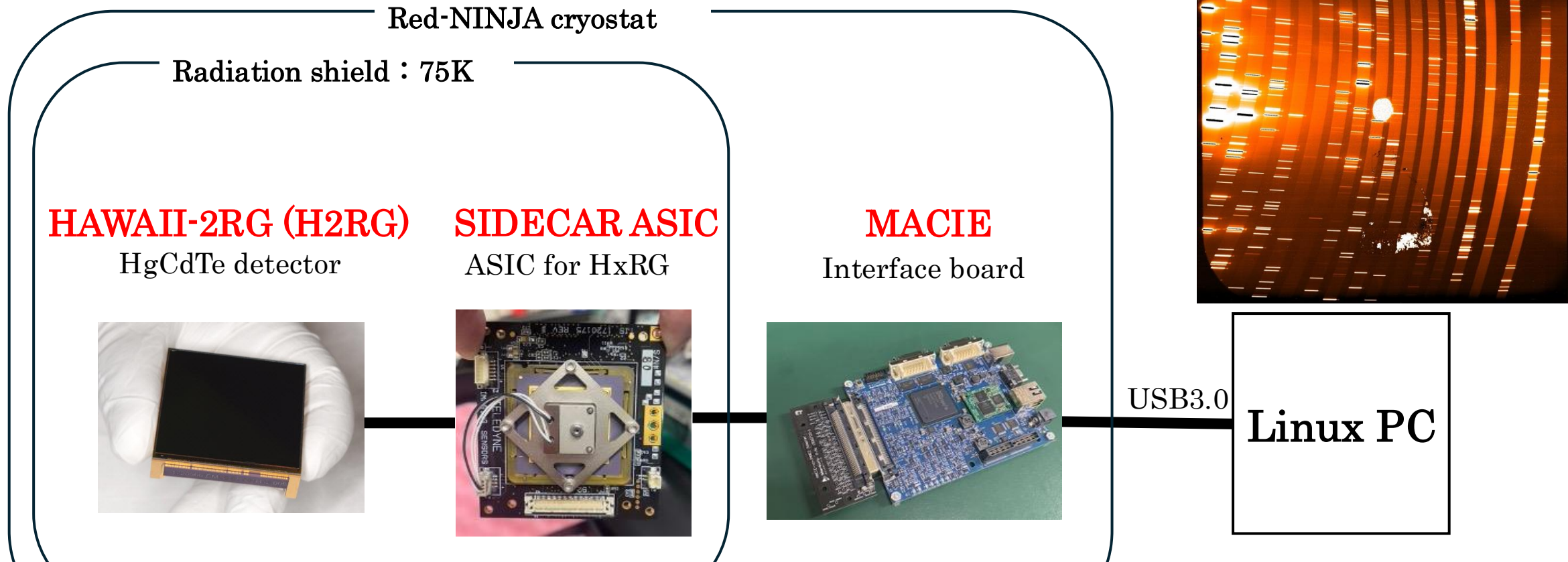
- **Detector**



Subaru Telescope

For more information, please visit **our poster P18**

Red-NINJA Detector System



When I first joined the NINJA team, I thought...
“All we have to do is to only attach these components??”

What We Really have to do

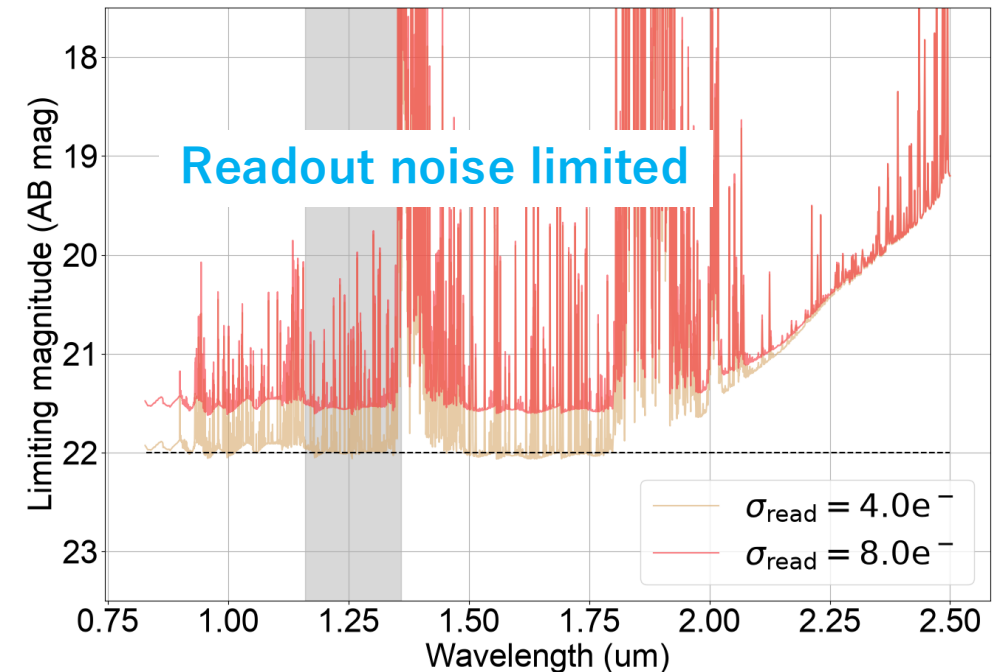
- Indeed, attachment of them is an important part of the development but **evaluating the detector performances** is crucial to Red-NINJA.

- Detector performances

- dark current
- non-linearity
- readout noise
- persistence
- glow

- For low readout noise, we conducted multi-parameter survey of the readout circuit
→ We've achieved $\sigma_{\text{read}} = 4 \text{ e}^-$ rms.

- Before evaluations, **we had to prepare the experiment setup.** **This talk**



Predicted limiting magnitude of Red-NINJA (S/N = 10, 2-hr exposure) calculated by R. Sato

Development Experiences; phase1

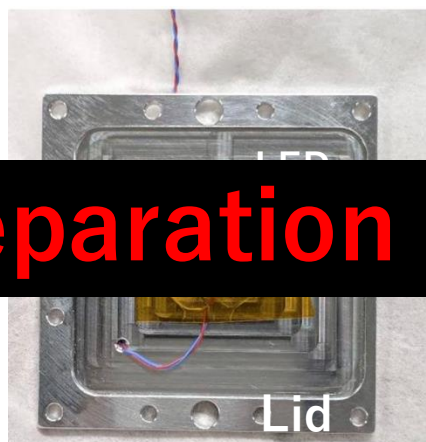
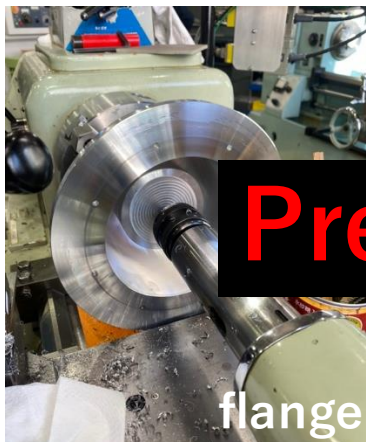
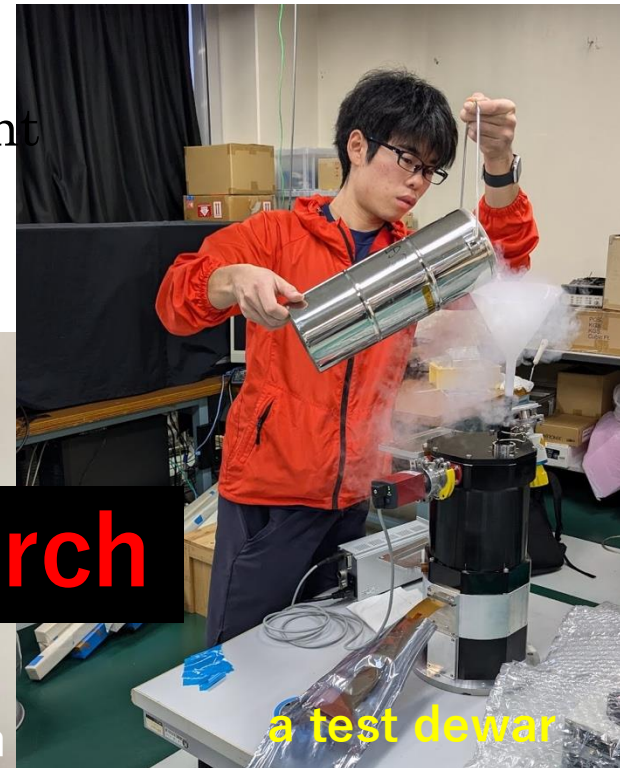
Detector evaluation in
a test dewar

Installation of detector
system to NINJA

Detector evaluation in
a NINJA cryostat

- For the setup, what is needed? what to buy, borrow, or fabricate?
 - For cryogenic environment; a test dewar, a vacuum pump, LN₂, a funnel (ろうと) → we borrowed or bought
 - For evaluating linearity and persistence; light-emitting environment
- Many jigs were fabricated or upgraded **by the ATC manufacturing team** based on my design drawings by CAD.

@ATC 2nd building



Preparation is 90 % of the research

Development Experiences; phase2

Detector evaluation in
a test dewar

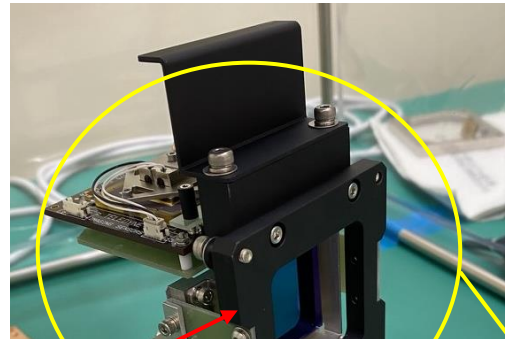
Installation of detector
system to NINJA

Detector evaluation in
a NINJA cryostat

@IoA clean room
(The Univ of Tokyo)



Removing the detector
from the test dewar



A jig for installation
of the detector

@ATC 3rd building



Installation into the NINJA cryostat

- An infrared detector is too expensive...
- very scaring but valuable experience

Development Experiences; phase3

Detector evaluation in
a test dewar

Installation of detector
system to NINJA

Detector evaluation in
a NINJA cryostat

@ATC 3rd building



- Test time was a **valuable shared resource**.
 - Other members shared the same cryogenic environment for their own tests.

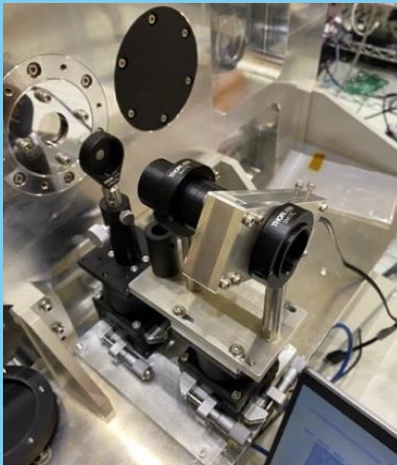
→ **I had to coordinate with the team**, secure time for my tests, and report the results to the team as soon as possible.

on a day,
At 8 pm, experiments started
At 9 am, experiments ended
At 12 pm, I reported the results

My Current and Future Researches

1. Optical alignment of Red-NINJA to the Subaru Telescope

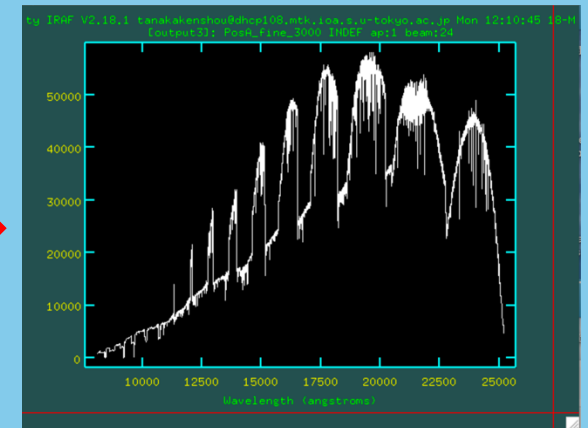
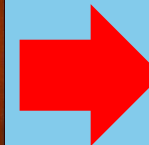
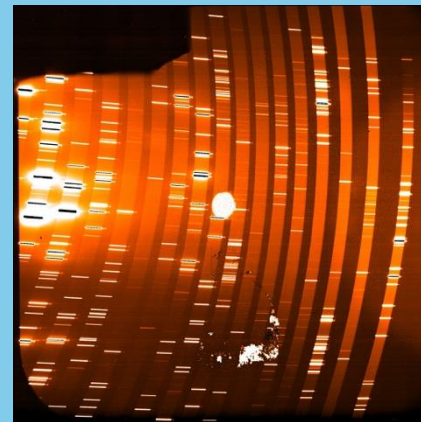
- will be conducted at Nasmyth platform



Jig for optical alignment

2. Pipeline development

- 2D spectral \rightarrow 1D spectral



3. I'm searching for new science cases achieved by NINJA

- The origin of elements
- Luminous red nova

Summary

- Red-NINJA is LTAO-optimized spectrograph covering 0.85-2.5 μ m with high sensitivity ($J_{AB} = 22$ mag (2-hr, S/N=10, R=4800)).
 - **3 graduate students** are participating in NINJA development.
- I have experienced so many hands-on experiments with aid of senior researchers.
 - Development = Getting familiar with the instrument with team members.
 - Hands-on experiments are most exciting for me.
- **Red-NINJA first light is scheduled in 2026.**
 - please visit **our poster P18.**

Acknowledgements

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