



# Status of the PRIME Near-Infrared Microlensing Survey : First year



Naoki Koshimoto

(Osaka University)

on behalf of the PRIME  
collaboration

# PRime-focus Infrared Microlensing Experiment

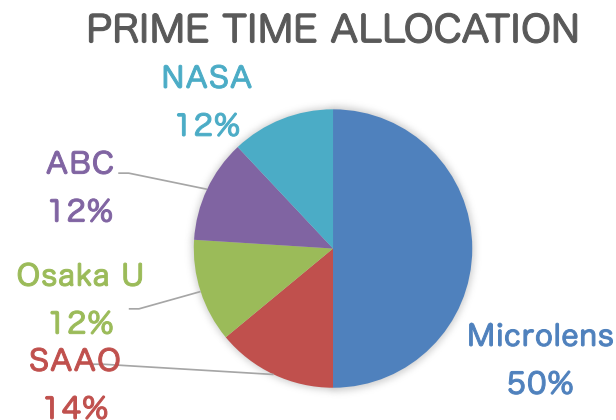


The first dedicated NIR microlensing exoplanet survey

- **H-band microlensing survey**
  - ✓ Find planets toward the inner bulge
  - ✓ Support Roman
    - Field optimization
    - Concurrent obs.

Off-bulge science :

- ToO (GW, GRB)
- Transit survey
- RV survey by SAND

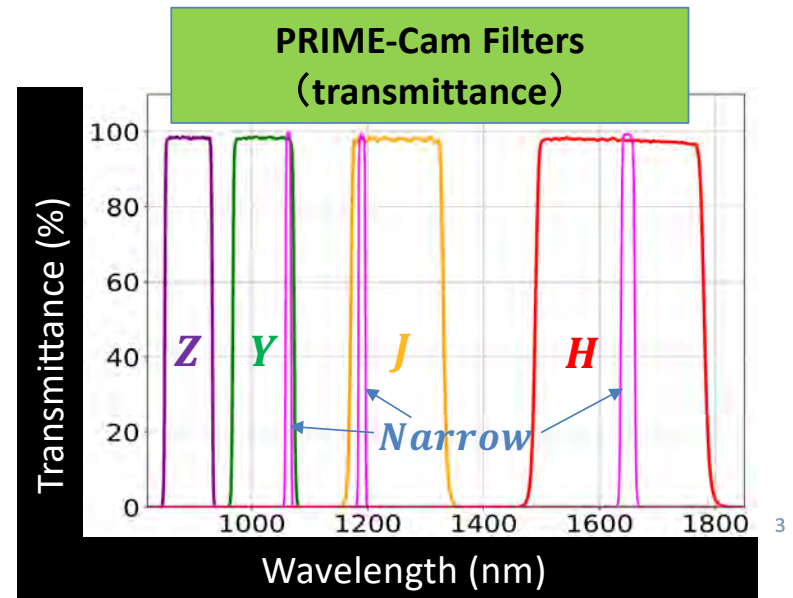
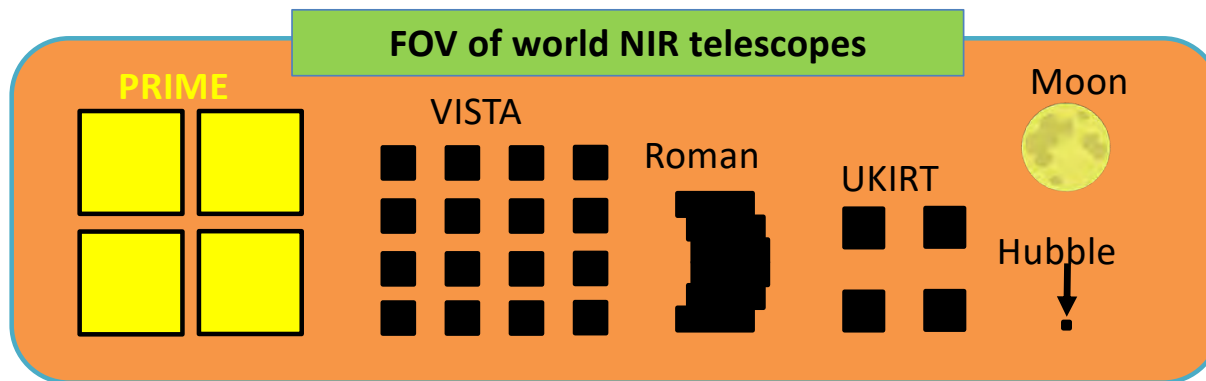
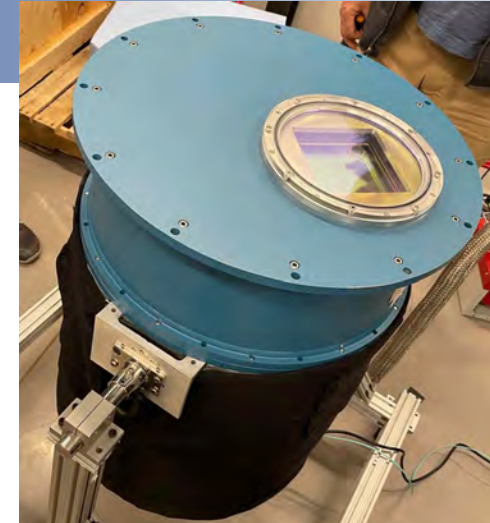


- 1.8m telescope @ SAAO
- 1.3 deg<sup>2</sup> FOV (H4RG x 4)
- **NIR filters** (Z, Y, J, H)

# PRIME-Cam



- ◆ Detector : **H4RG-10 × 4** → 64M pix
- ◆ FOV : **1.3 deg<sup>2</sup>**
- ◆ Filter : *Z, Y, J, H-band + Narrow-band*
  - Microlensing survey will use *H-band*.
- ◆ Limiting mag : 18.5 mag (*H*, Vega, integration time 100 s)
- ◆ Manufactured in Goddard and shipped to SA on Aug 2022.

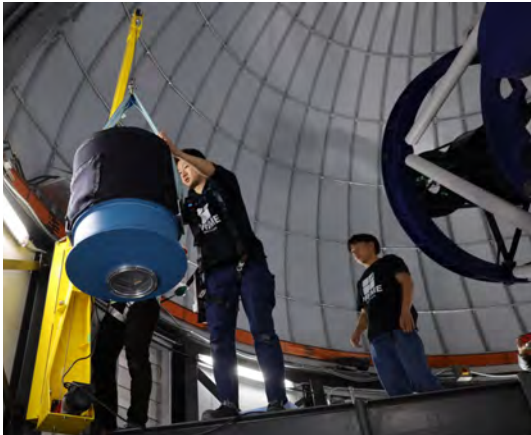


# PRIME activities since Oct 2022



Achievement Issue

Oct 2022 - **PRIME-Cam installed** and first science result (GRB)!



First PRIME science result  
(Durbak et al. 2022, GCN)



# PRIME activities since Oct 2022



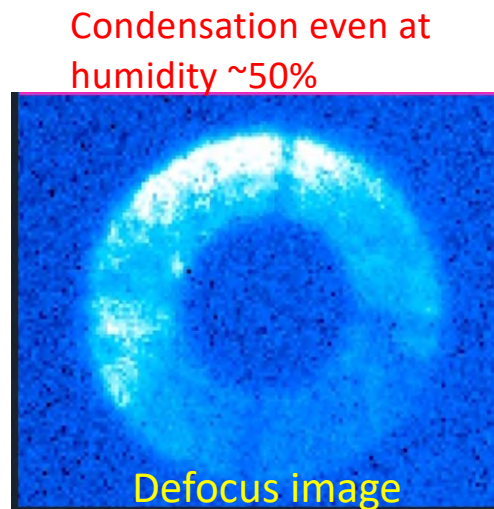
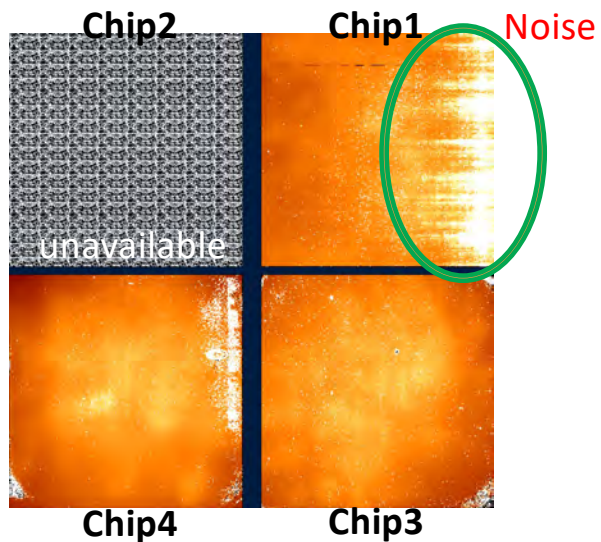
## Achievement

## Issue

- Oct 2022
- **PRIME-Cam installed** and first science result (GRB)!
  - Chip 2 unavailable because ACADIA (ROIC) was broken during shipping
  - Frequent condensation of dewar window
  - Too bright thermal BG (leak from uncoated edge of cold window)

Thermal background @ 290 K

Filter	Before (ADU/s)	
Z	<b>1445</b>	
Y	<b>1345</b>	
J	<b>1065</b>	
H	<b>1609</b>	



# PRIME activities since Oct 2022



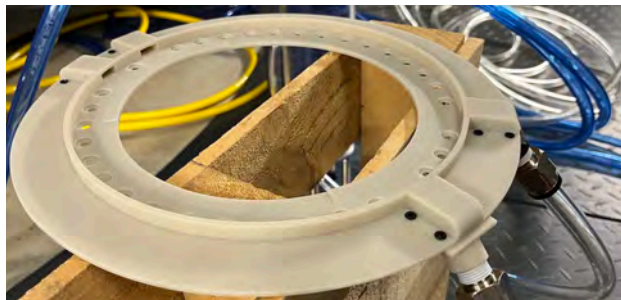
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- ↓
- Feb 2023
- **Replace dewar window and flanges and adjust the direction of dry-air**

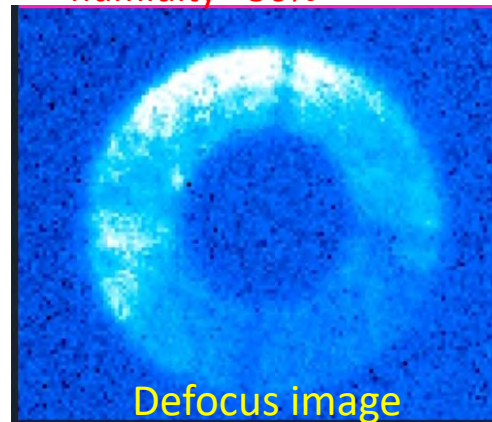
Thermal background @ 290 K

Filter	Before (ADU/s)	After (ADU/s)
Z	1445	233
Y	1345	270
J	1065	255
H	1609	419

Flange to adjust the direction of dry-air

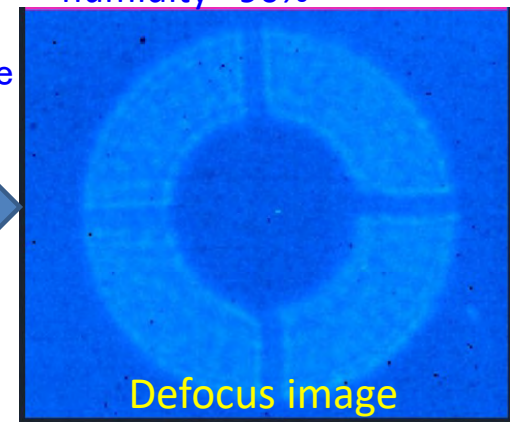


Condensation even at humidity ~50%



Defocus image

No condensation even at humidity ~90%



Defocus image

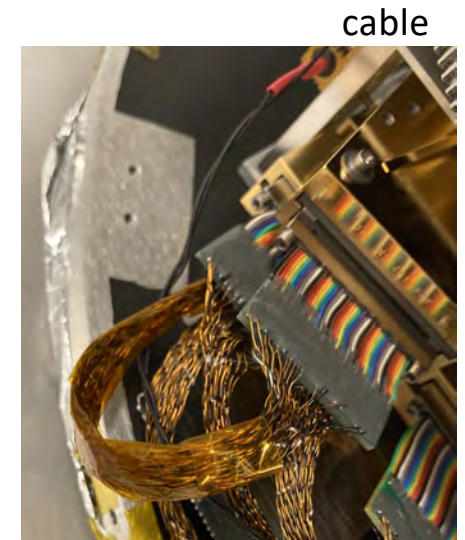
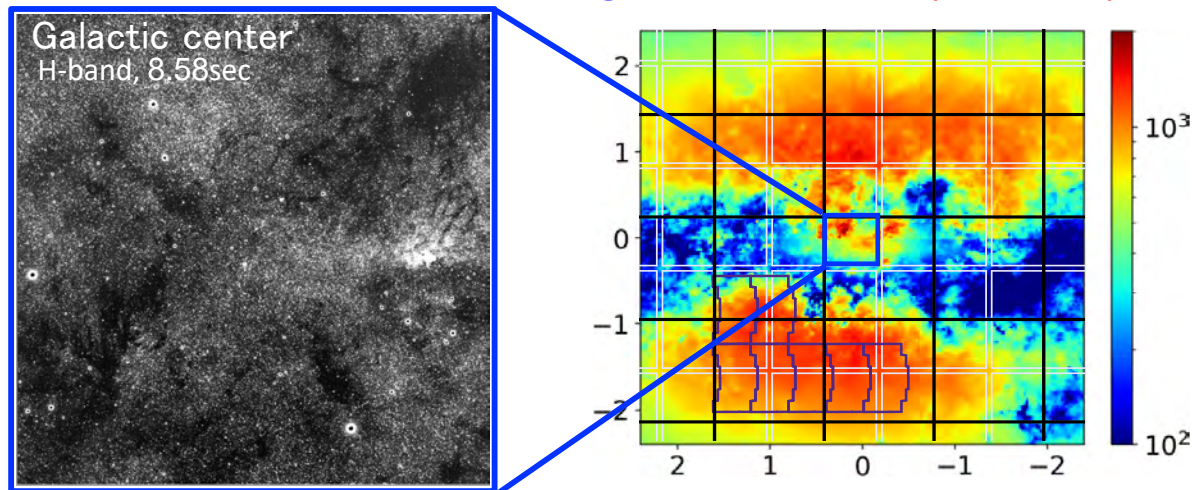
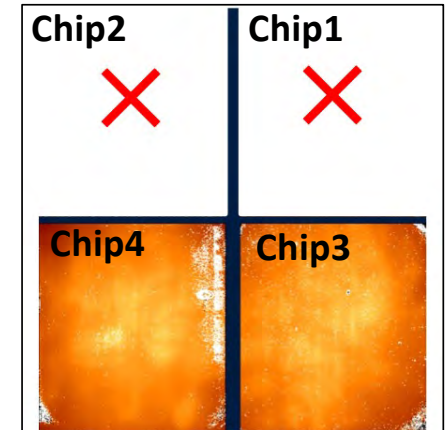
New flange installed

# PRIME activities since Oct 2022



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  - **Test observation toward the bulge started** but only with chip3 & 4



# PRIME activities since Oct 2022



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June-July  
2023

- Replace ACADIA and cable, and **all four chips became available!**
- Optical alignment → **Hartman constant  $\sim 0.35''$**   
→ **Detector tilt  $70''$  ( $< \text{tolerance } 120''$ )**





# PRIME activities since Oct 2022



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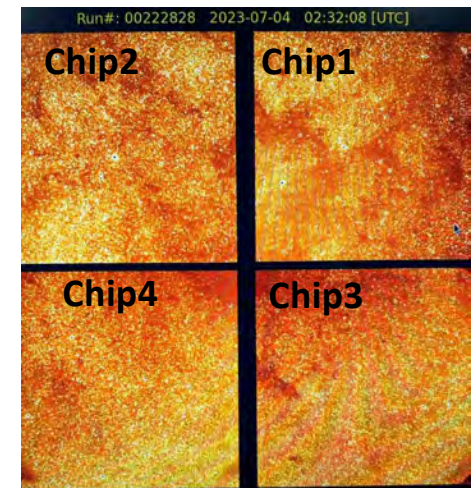
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- **Bulge survey started** with all four chips!  
(Off-bulge: pre-defined all sky grids for ToO reference and ToO like GRBs are observed)
- But we started to have a higher detector temperature issue...

GC image with four chips



# PRIME activities since Oct 2022

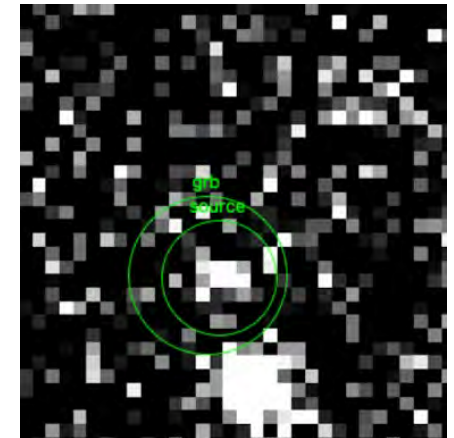


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GRB follow-up on Jan 23 2024



Feb 2023

- Replace dewar window and flanges and adjust the direction of dry-air
- ~~- Chip 1 became unavailable (cable connection issue)~~
- **Test observation toward the bulge started** but only with chip3 & 4

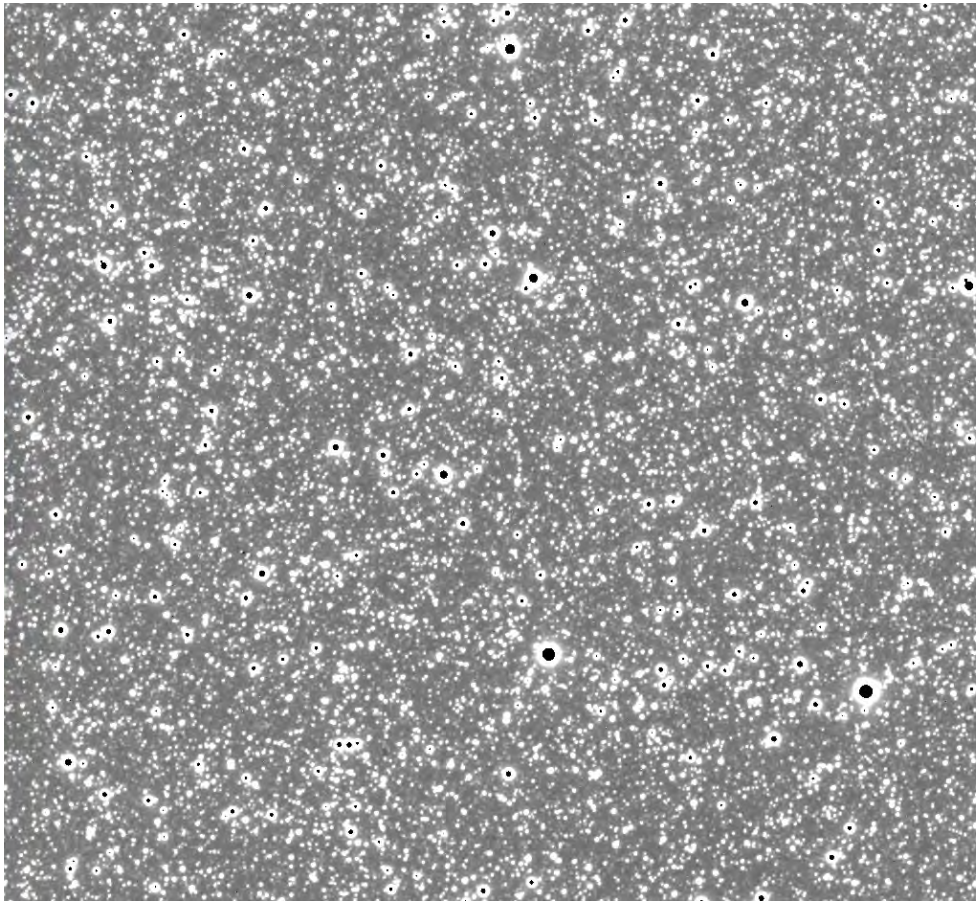
June-July  
2023

- Replace ACADIA and cable, and **all four chips became available**
- Optical alignment → **Hartman constant ~0.35"**  
→ **Detector tilt 70"** (< tolerance 120")

Band	Mag (AB)	S/N	Seeing	Exp.(sec)
J	21.02 +/- 0.20	6.3	1.373"	1802
H	20.90 +/- 0.21	6.1	1.480"	1544

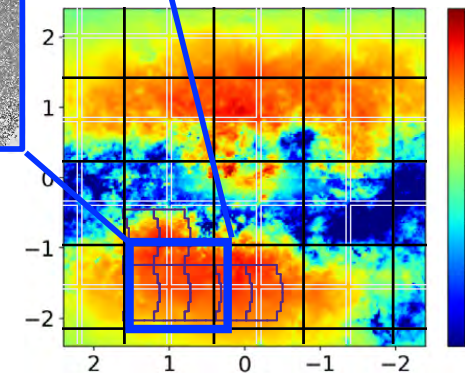
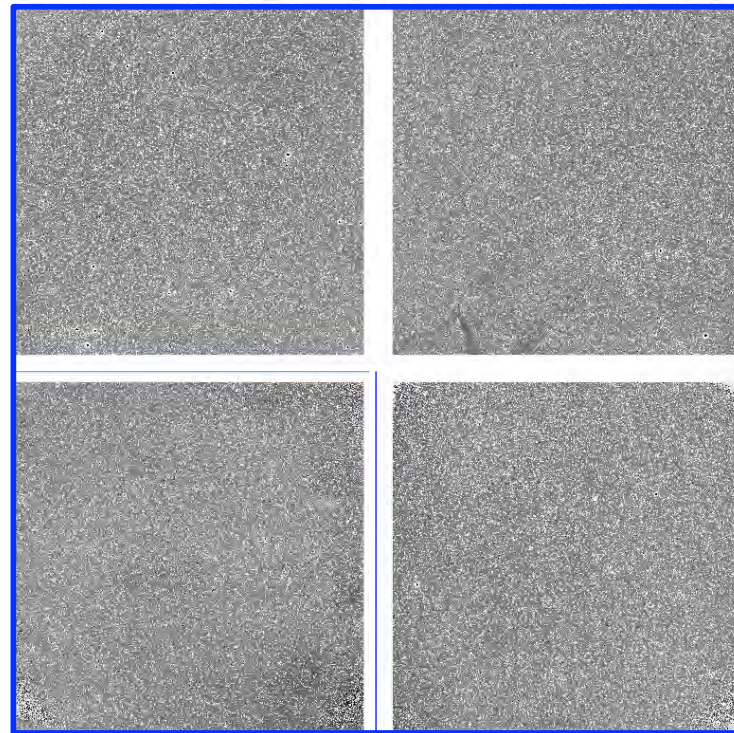
- **Bulge survey started** with all four chips!  
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- ~~- But we started to have a higher detector temperature issue...~~

# Bulge survey has started on July 2023!

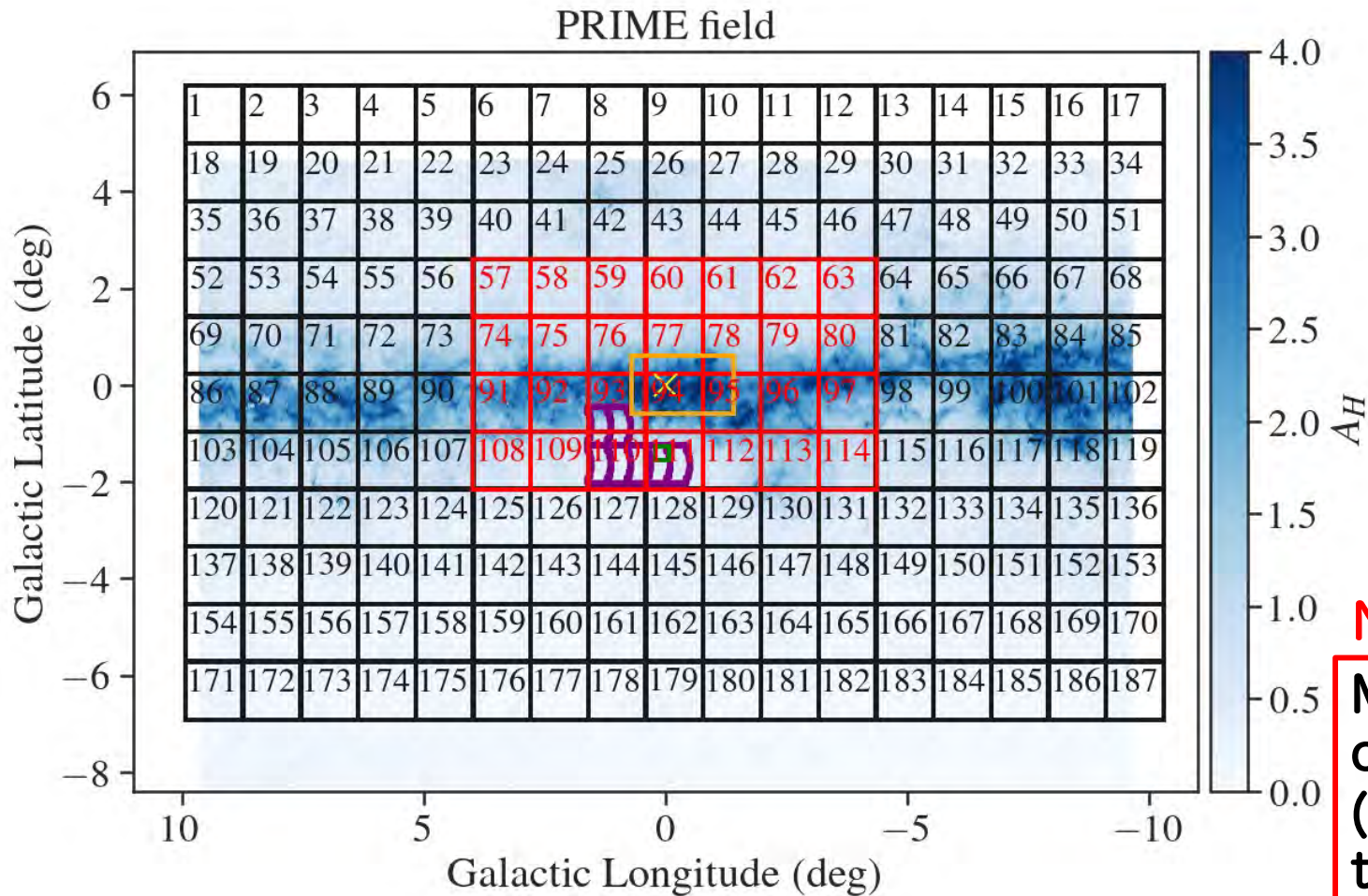


H-band, 8.58 sec.

Roman field



# PRIME bulge survey field



**PRIME Survey Field**  
(3-4 per night till 2024?)

**Roman Survey Field**  
(tentative)

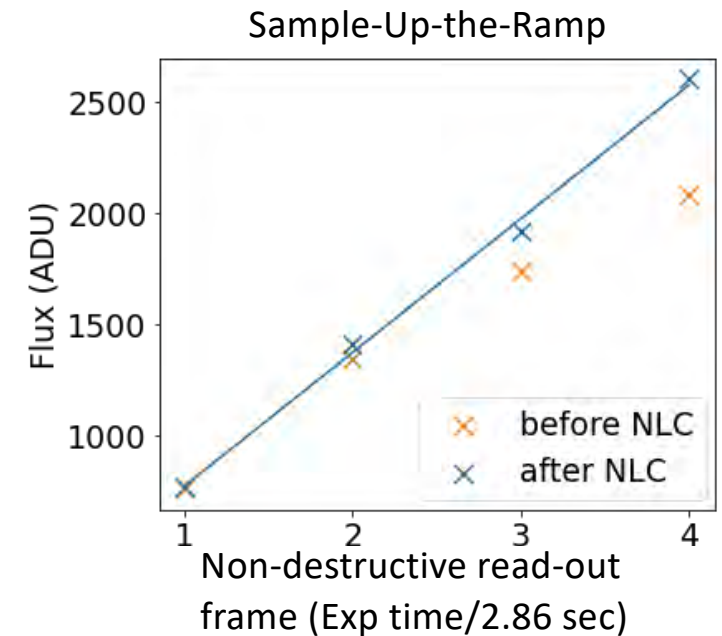
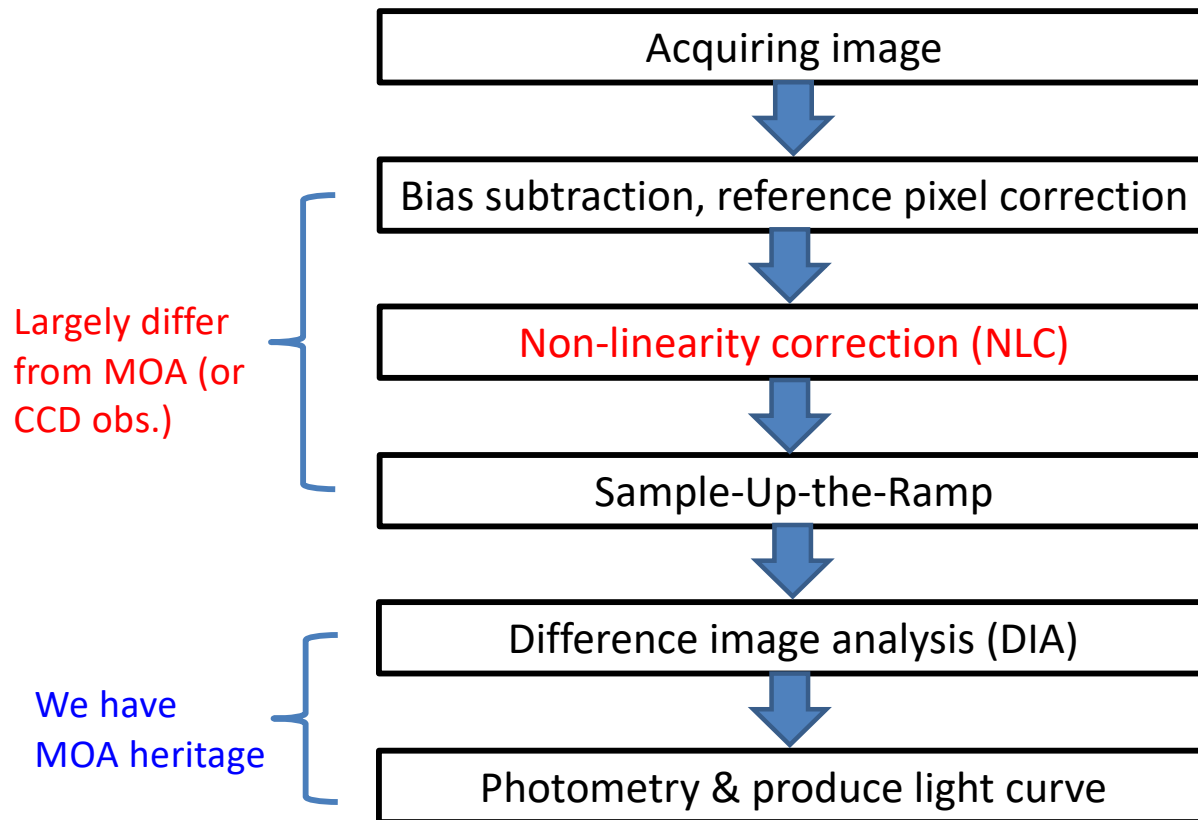
**Chandra Field**  
**JASMINE Field**

**Near-term first priority**

**Make event-rate map to optimize the Roman field (at least tentative one by the end of 2024)**

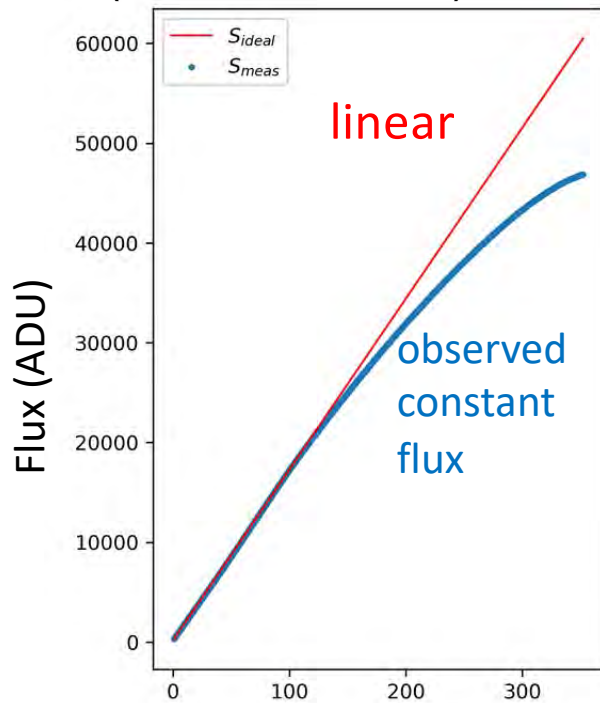
# Data processing procedure

- We have been developing data reduction pipeline
- Each field is observed by 12 x 11.44 sec exposures
- Each 11.44 sec exposure consists of 4 non-destructive read-out frames (2.86 sec/frame)



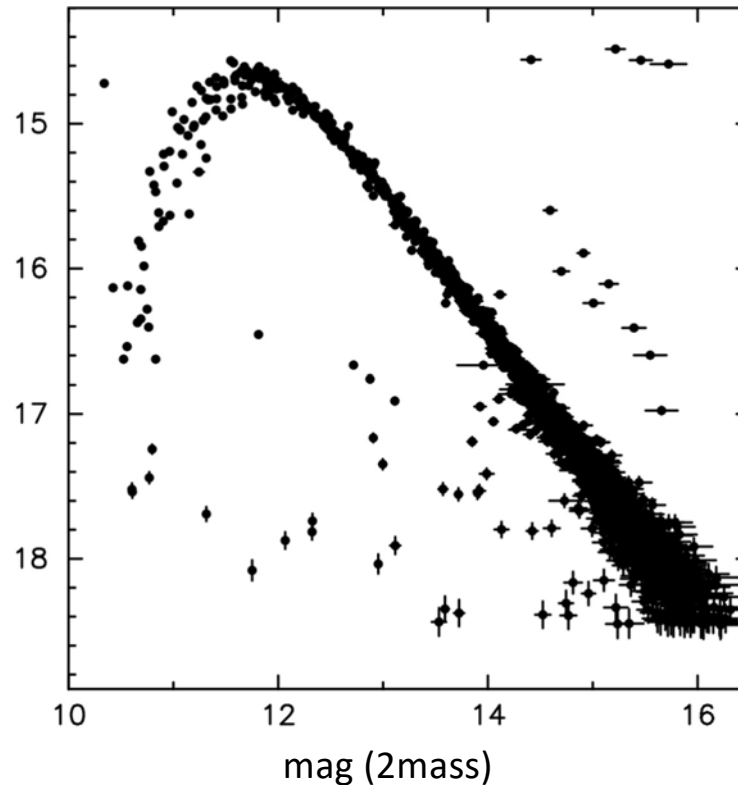
# Classical non-linearity correction (CNLC)

Modeled by polynomial  
(used for JWST)

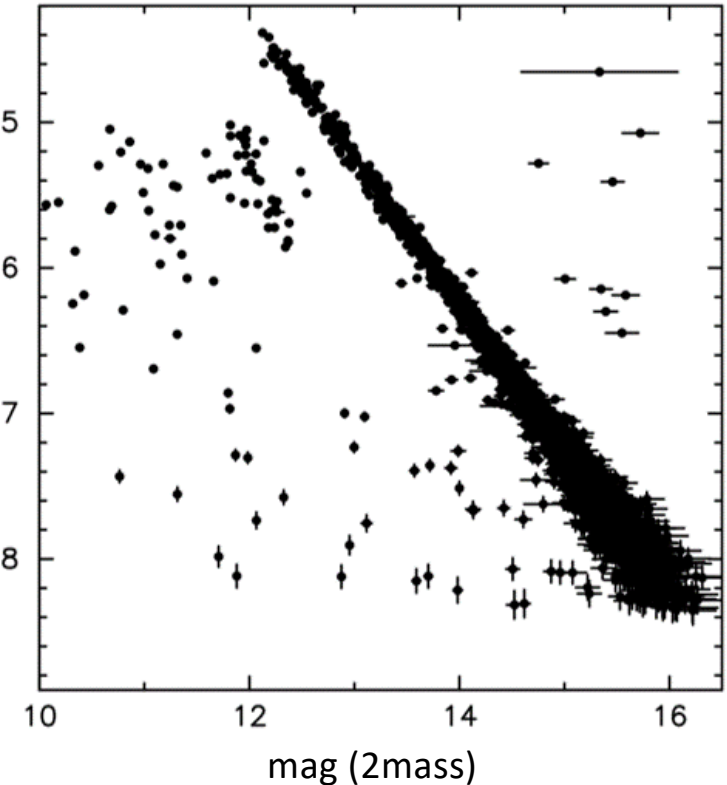


Non-destructive read-out  
frame (Exp time/2.86 sec)

before correction

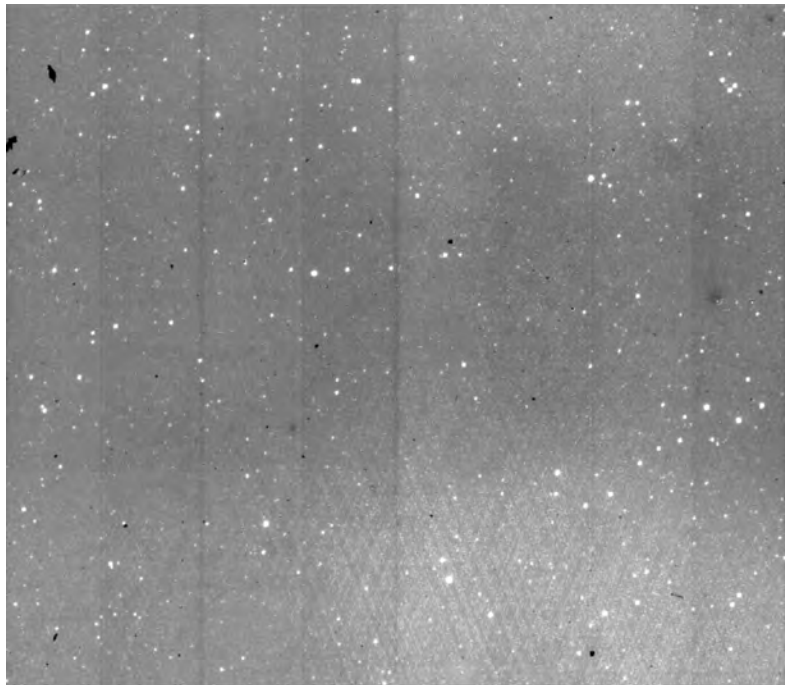


After correction

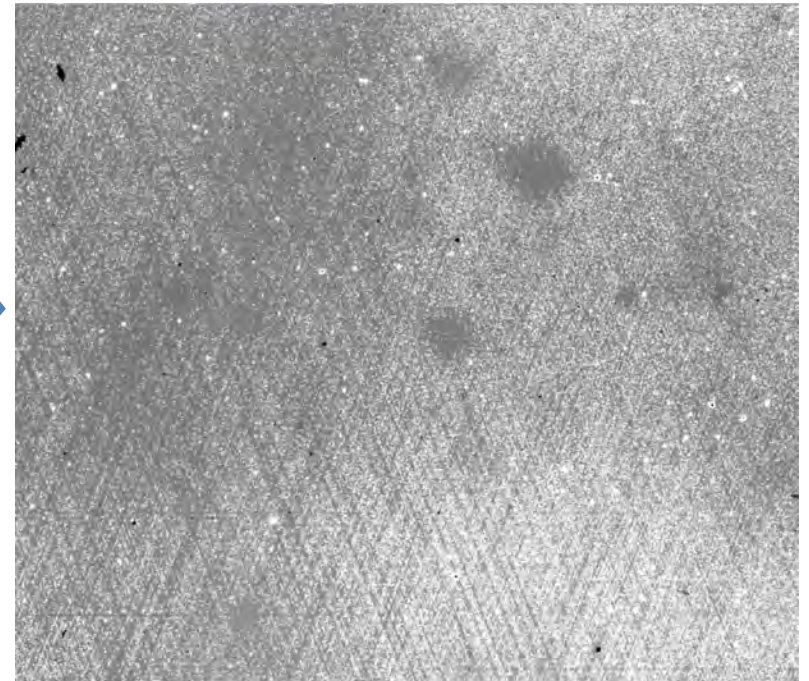


→ CNLC worked successfully for good pixels

# CNLC doesn't work for hot/warm pixels



Classical  
non-linearity  
correction  
(CNLC)

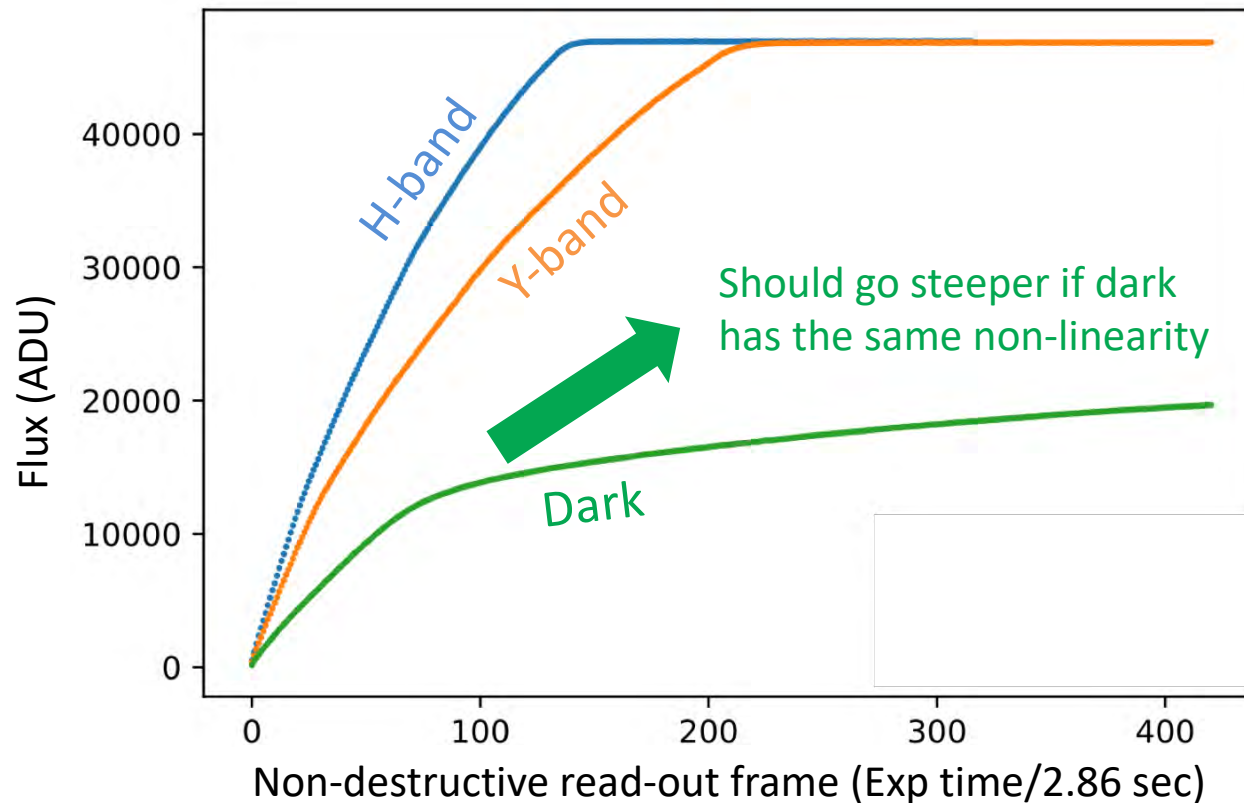


CNLC doesn't work for hot/warm pixels

- The number of hot/warm pixels were negligible when observing with chip3 & 4
- Hot/warm pixels increased (~40% for chip4) due to higher detector temperature (~108 K → ~117 K) since the recovery of chips 1 & 2.

# Non-linearity in hot/warm pixel

Long exposure with stable light source

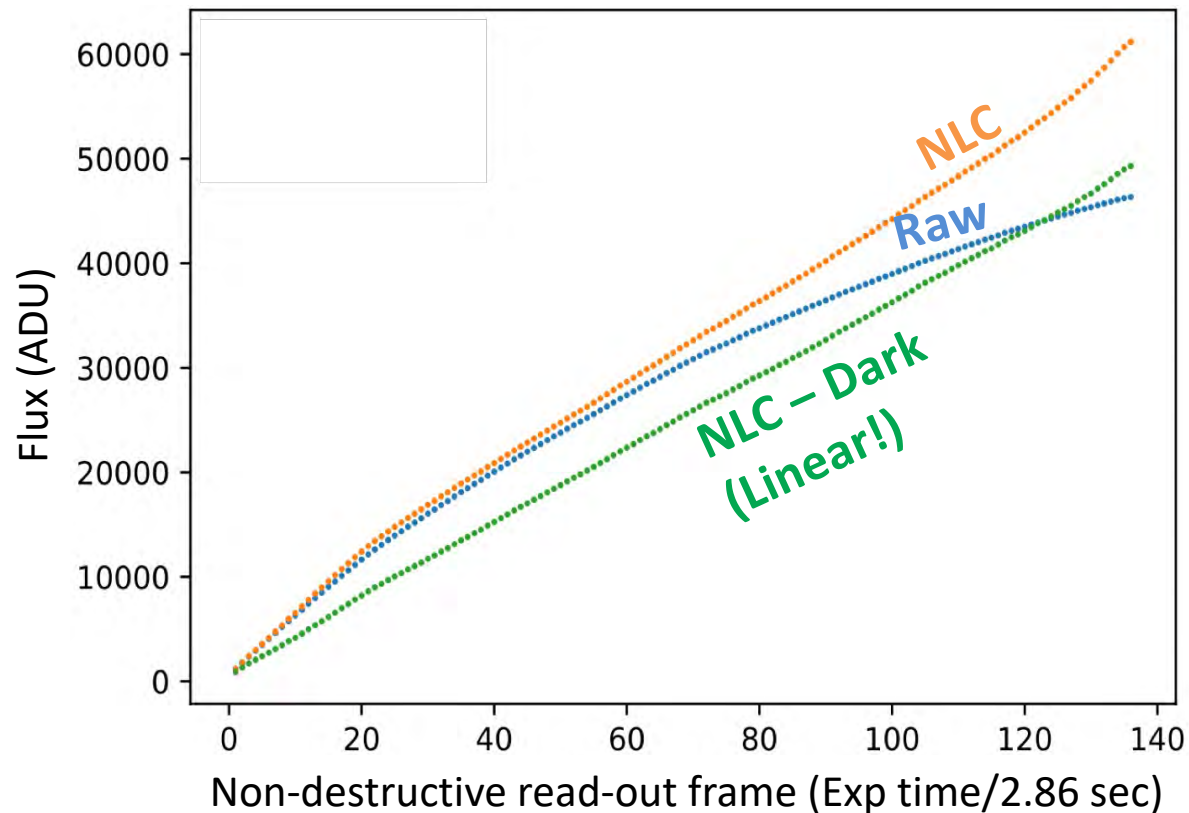


→ Dark seems to have a different non-linear behavior than normal signal...

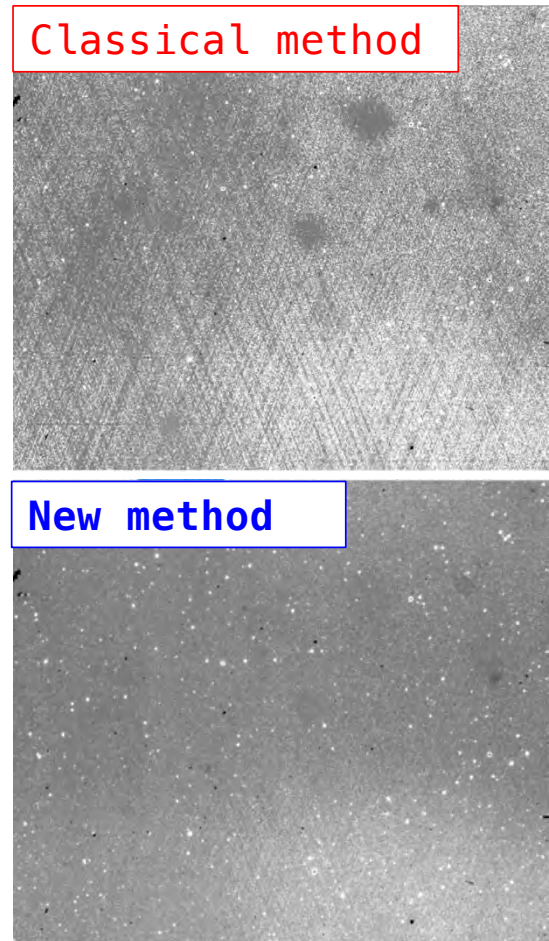


# New NLC method developed (Hamada+)

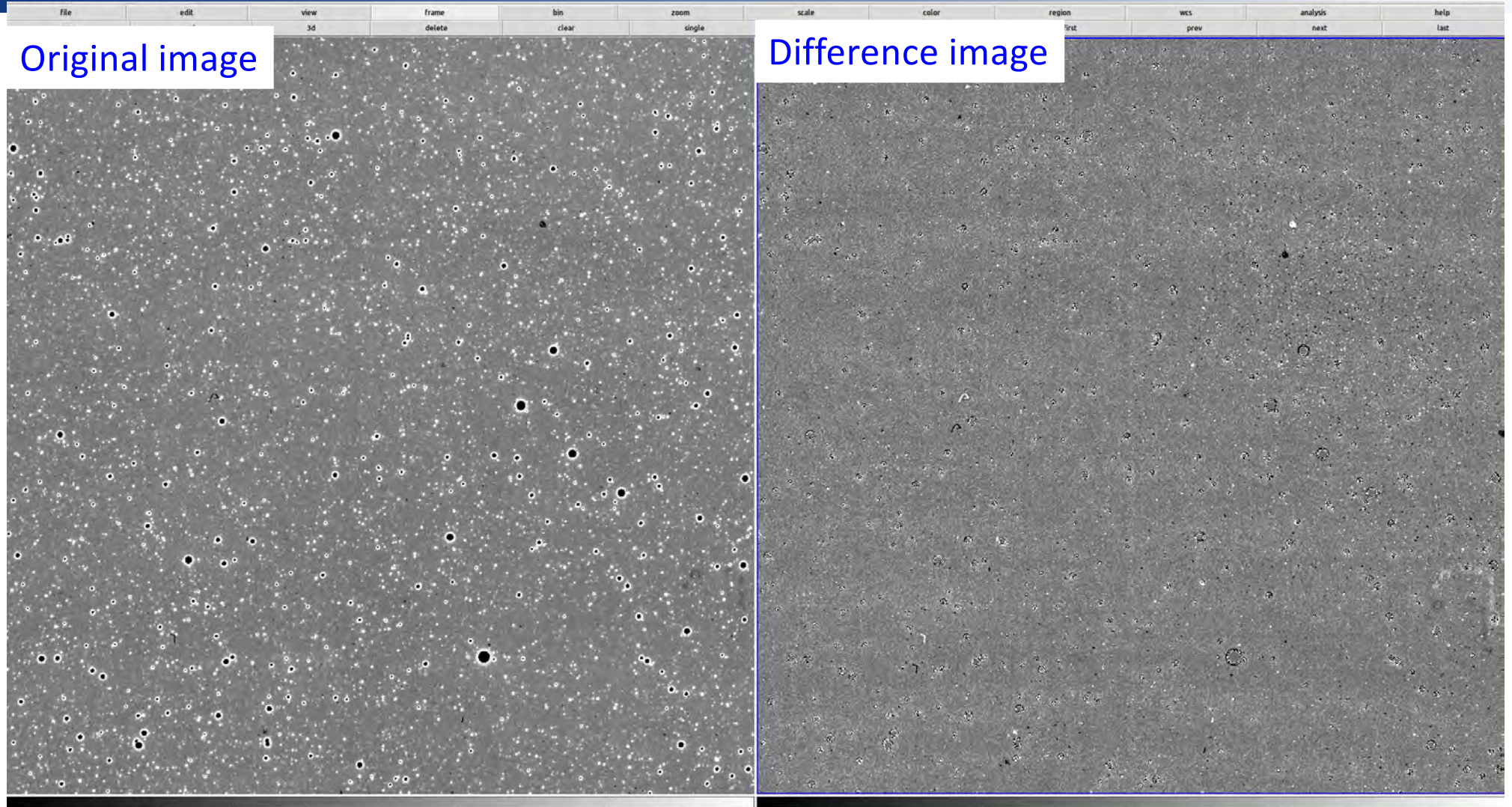
- New method for NLC taking into account high dark current developed (Hamada+ in prep.)



→ might be also useful for Roman's warm pixels??

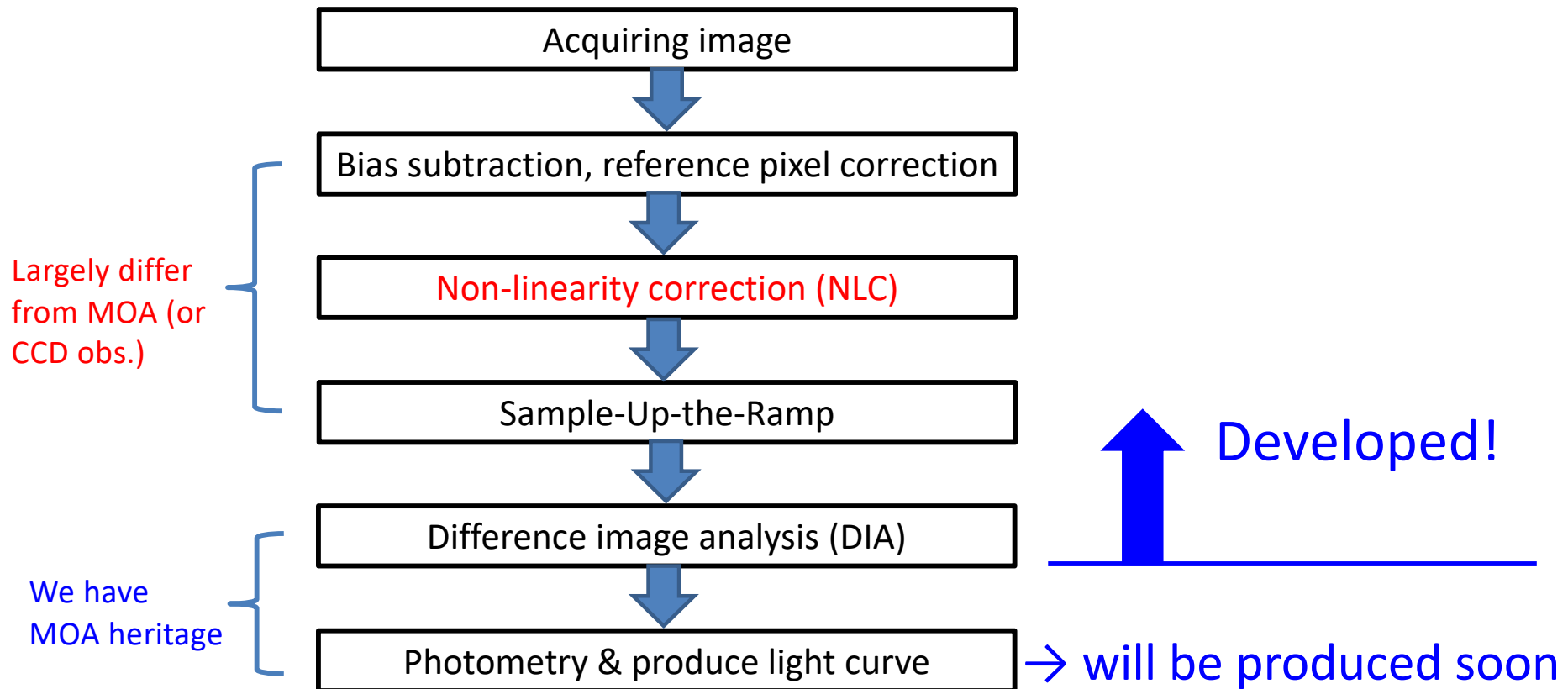


# DIA worked!



# Data processing procedure

- We have been developing data reduction pipeline
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# Summary

- **PRIME bulge survey has started** on July 25
- New method for non-linearity correction was developed
- Data reduction pipeline is mostly developed, and light curve will be produced soon