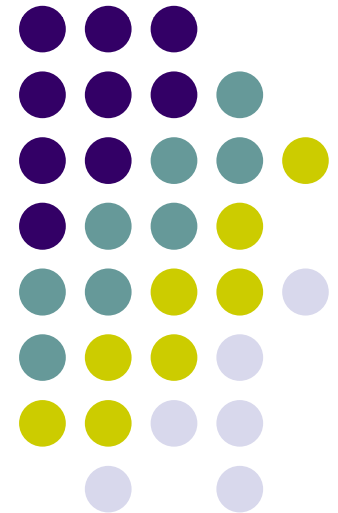


# Phase-3 IRC data & imaging pipeline

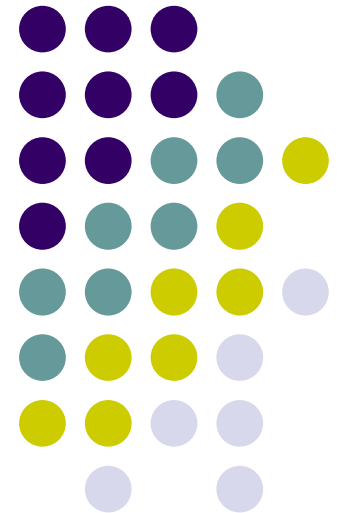
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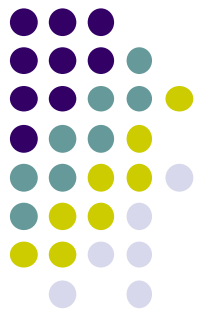
Yoshifusa Ita  
& IRC team



# Part 1: Phase3 IRC data

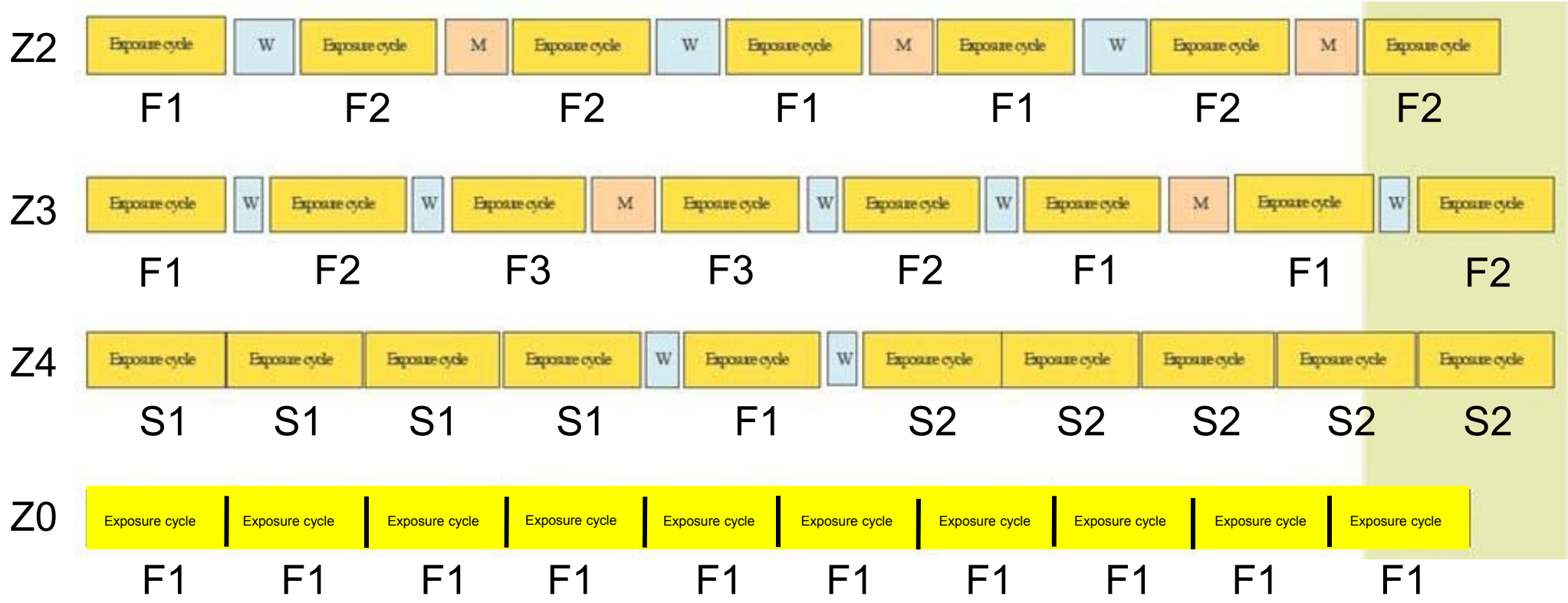
- Differences from the Phase1&2
  - Observation sequence
    - Now it takes 10 dark images
  - Data quality
    - PSF
    - Sensitivity
    - Linearity, Saturation limits

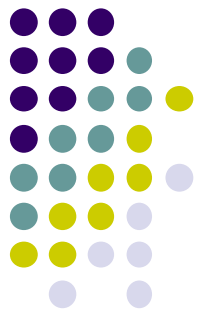




# Observation sequence in Phase3

Exposure time (Long&Short) is same as in Phase1&2

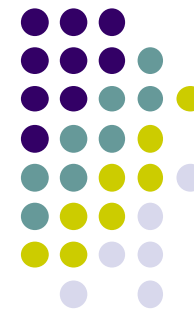




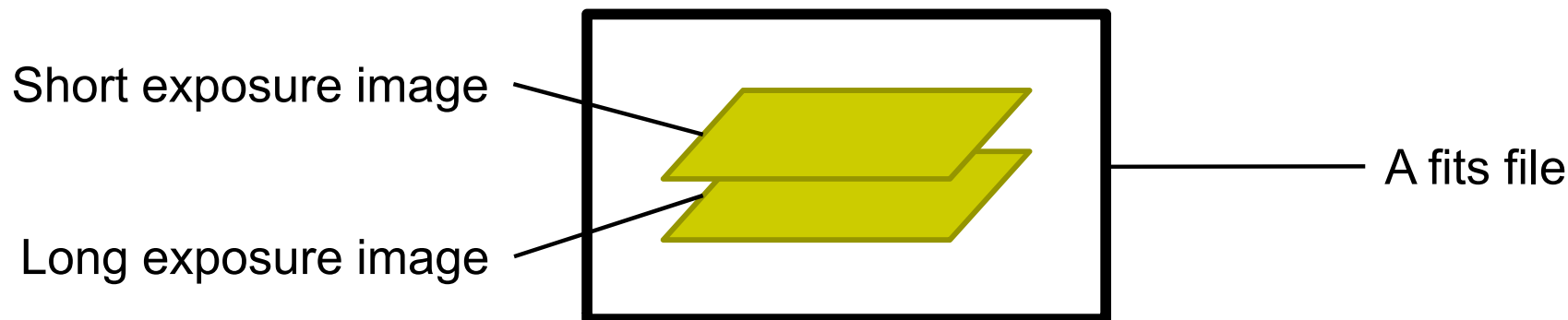
# Observation sequence: differences from P1&2

- Take 5 dark images BEFORE observing a target.
- Take 5 another dark images AFTER observing a target.

In total, 10 dark images are taken in 1 pointing.  
(cf. only 2 NIR dark images were taken in P1&2)



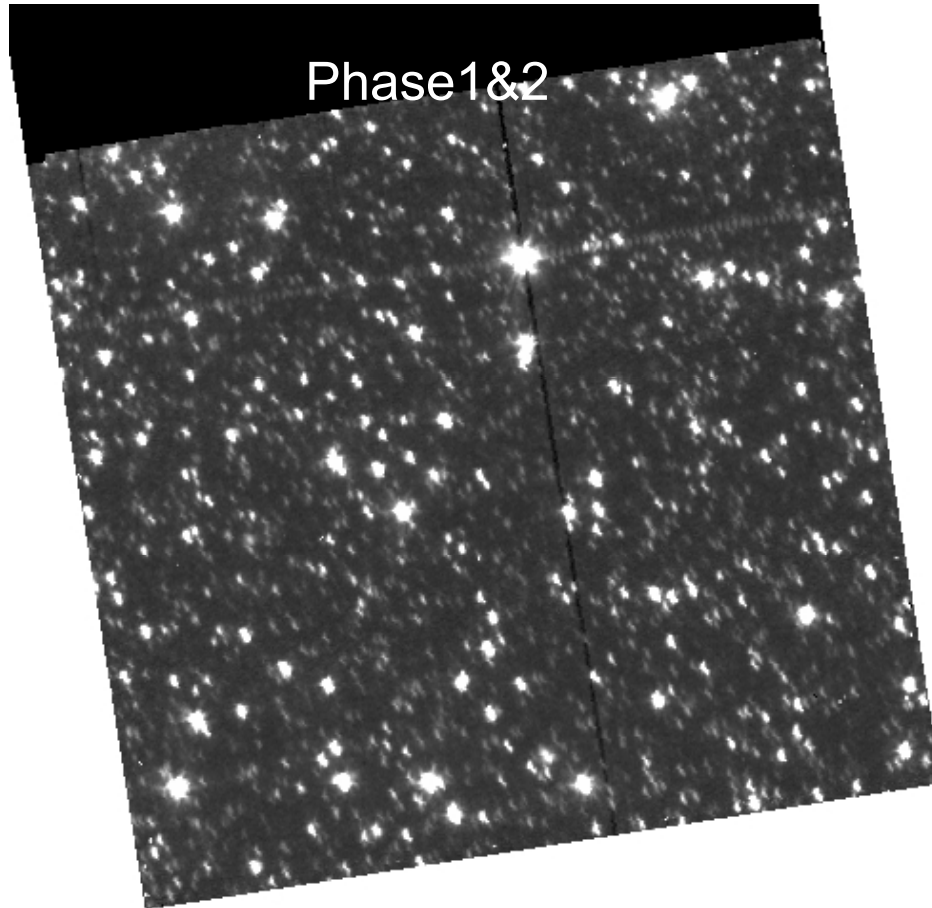
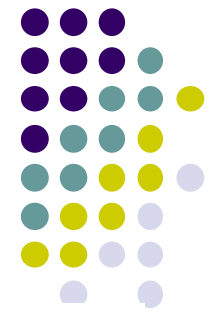
# Structure of IRC fits file



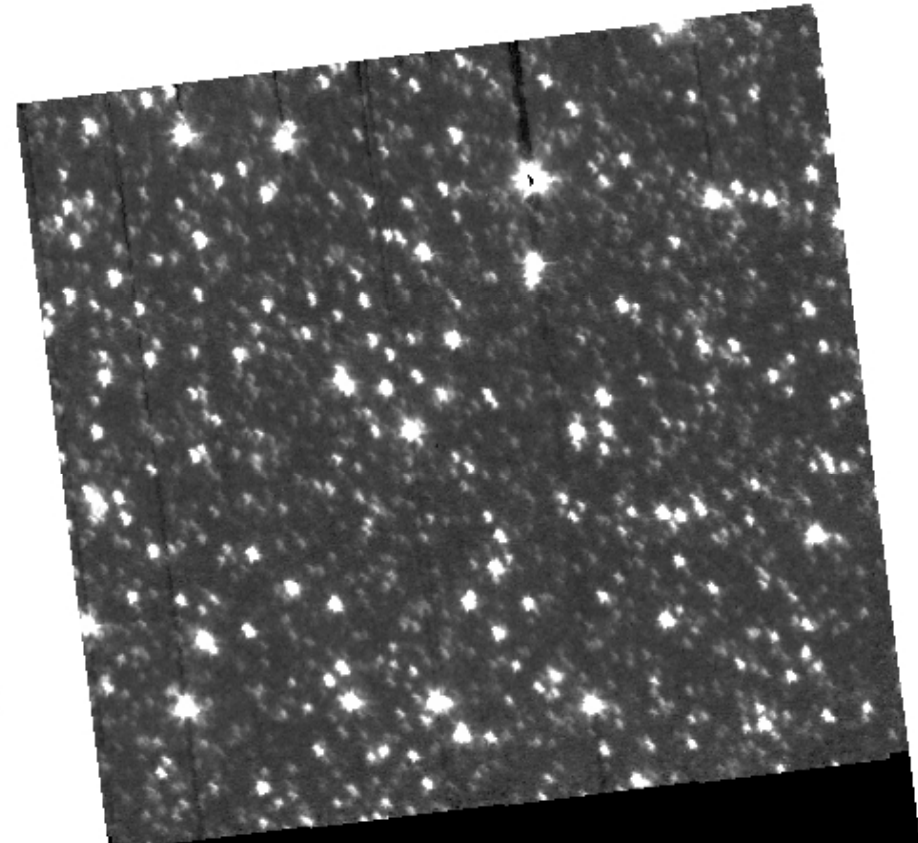
- **The IRC FITS data is not a usual 2D one.** A raw data FITS file is created for each Exposure Cycle during a pointing for the NIR channel. (1 NIR FITS file per Exposure Cycle). The filename format is given as F\*\*\*\*\* N.fits, where \*\*\*\*\* is a distinct incremental reference number.
- A NIR raw fits file is a data cube containing 2 image within it, corresponding to one short and one long exposure.

# Data quality (1)

## Broad overview



The same field observed in Phase 3

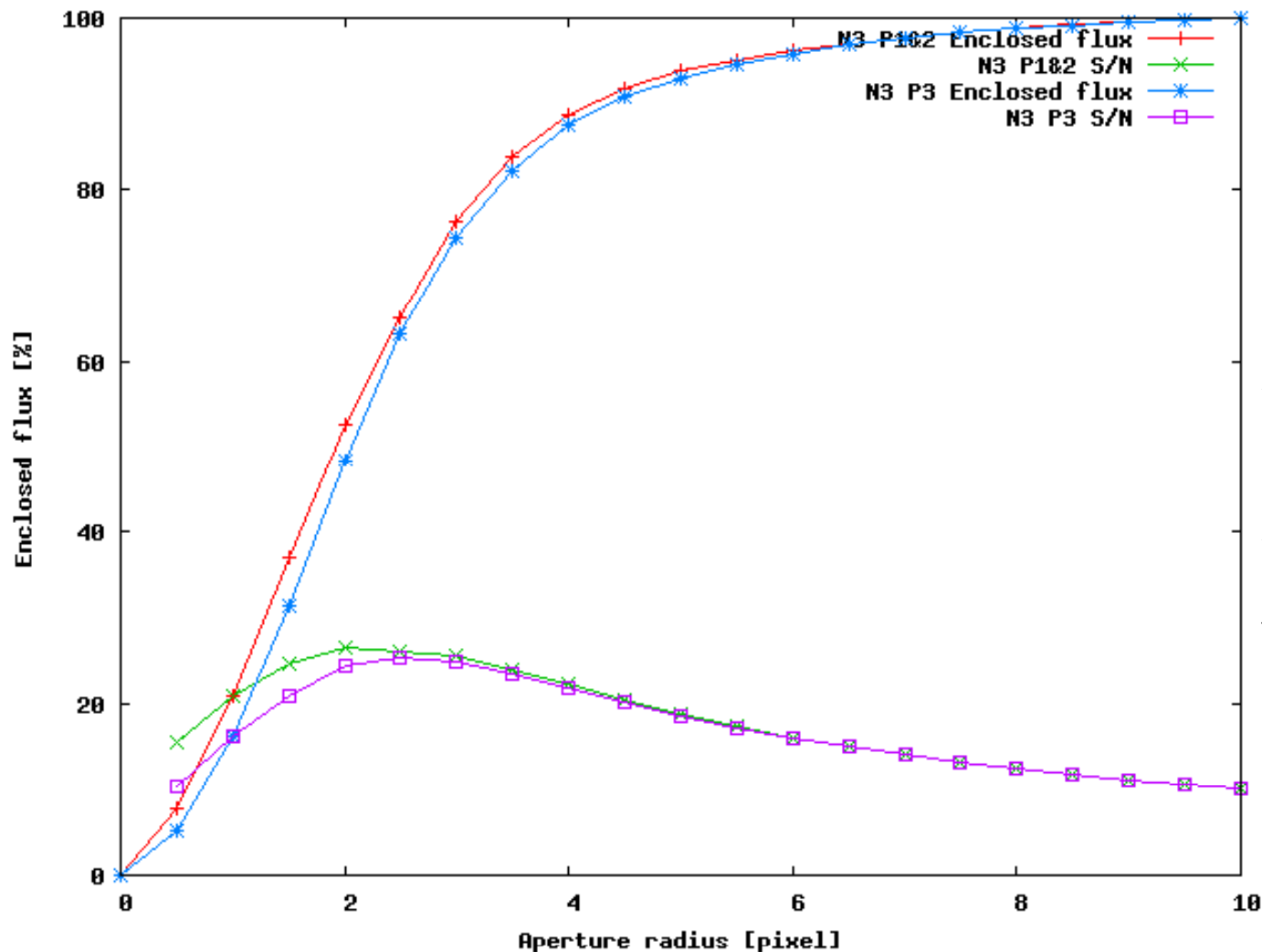


PSF and Saturation limits get worse.  
Image gets noisy



# Data quality (2)

## PSF: slightly get worse



Assumption:

$$Signal = Const * EE(r_{aperture})$$

$$Noise = \sqrt{\sum_i^{N_{pixel}} noise_i^2} = \sqrt{N_{pixel}} * noise_{pixel}$$

$$N_{pixel} = \pi * r_{aperture}^2$$

$$\frac{Signal}{Noise} = \frac{Const}{\sqrt{\pi} noise_{pixel}} * \frac{EE(r_{aperture})}{r_{aperture}}$$

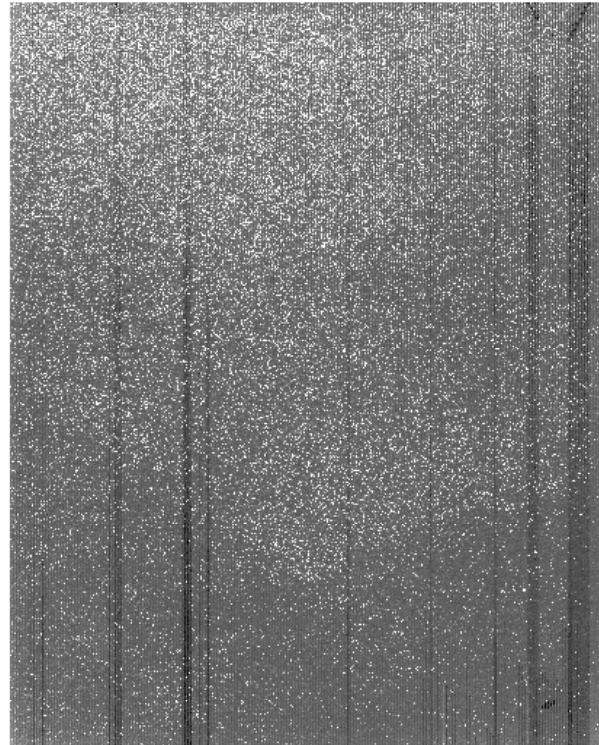
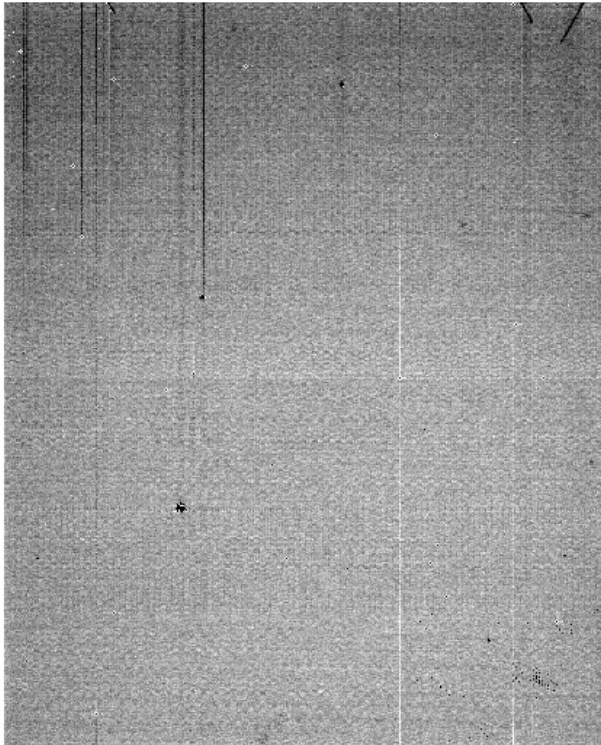
i.e.,  $S/N \propto EF(r)/r$



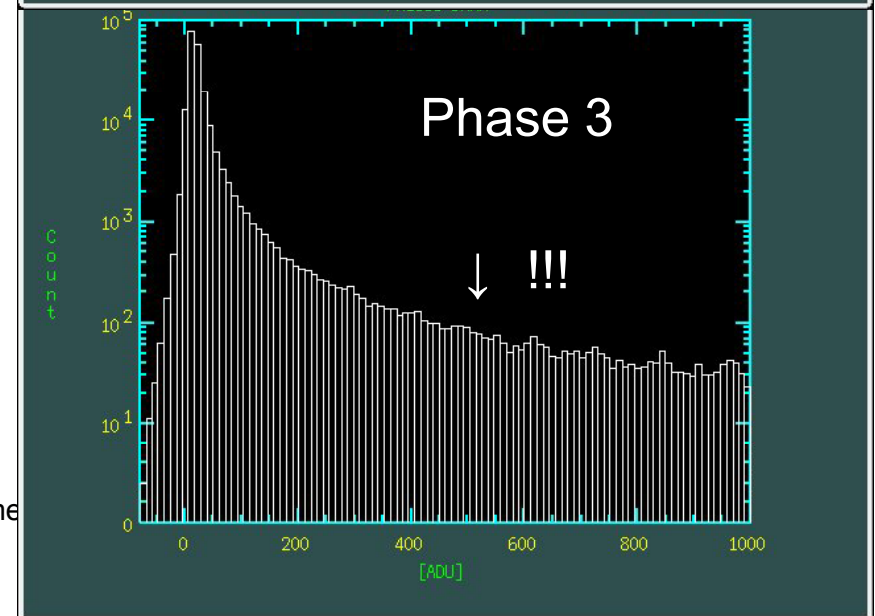
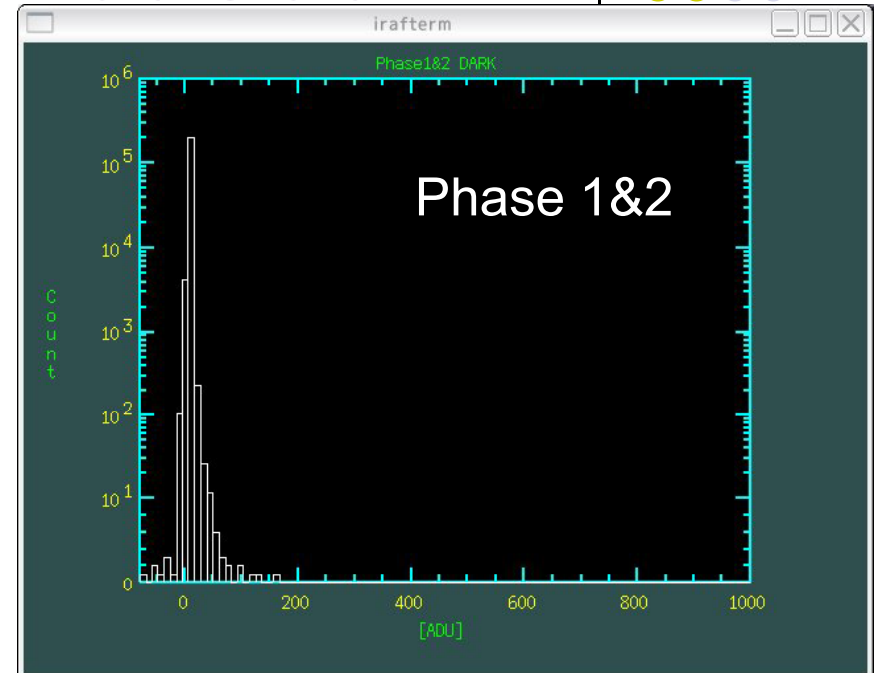
# Data quality (3)

## No. of Hot pixels: Increased

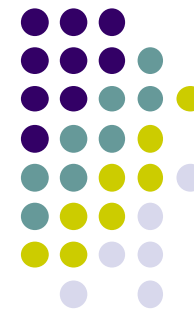
Dark image in Phase1&2    Dark image in Phase3



Number of hotpixels -> Significantly increased.

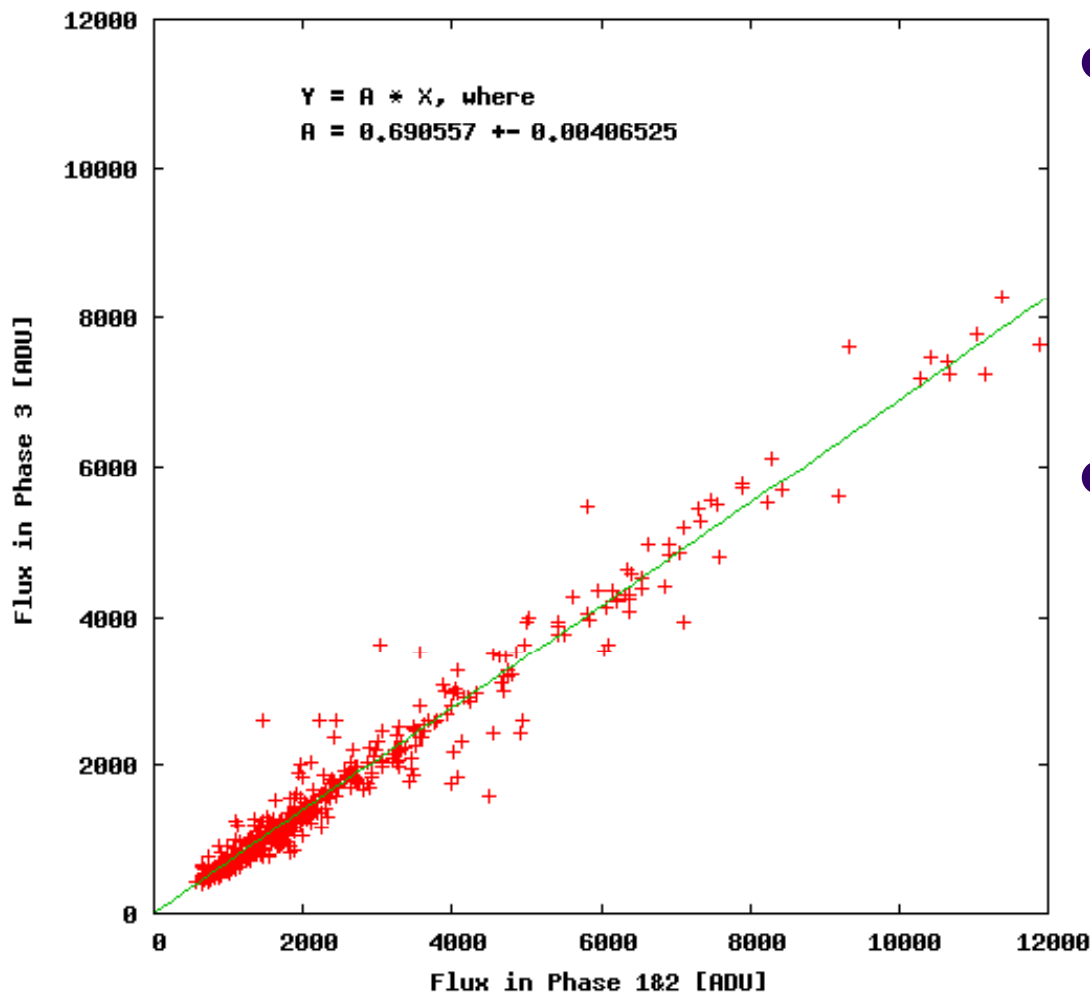






# Data quality (4)

## Sensitivity: get worse by 0.7



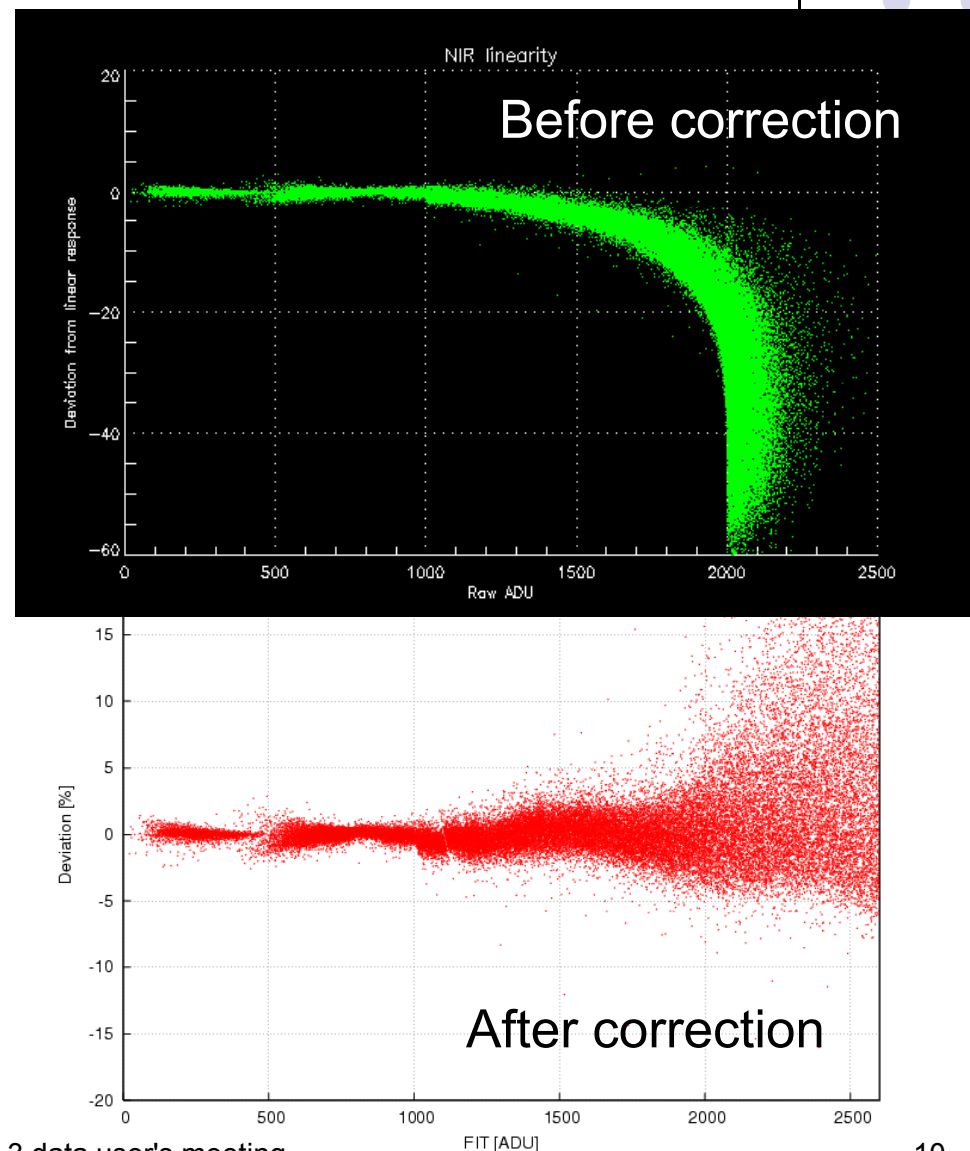
- Compared the aperture photometry fluxes of the same star.
- Assuming that the system throughput has not changed.

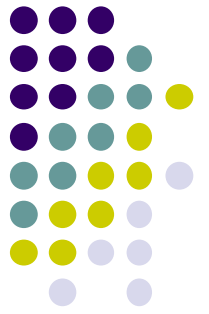


# Data quality (5)

## Dynamic Range: get 1/6

- Dynamic range get narrow
  - 12000 ADU -> 2000 ADU
  - get 1/6
- Saturation Limit get worse
  - About 9 mJy at N3@Long
  - Cf. about 30 mJy in Phase1&2
- Detector linearity
  - measured with in-flight data taken in PV2 phase.
    - Take calibration lamp image with increasing range of integration time
  - after the correction, the deviation from the ideal linear curve is better than  $\pm 5\%$  at the DN of 2000

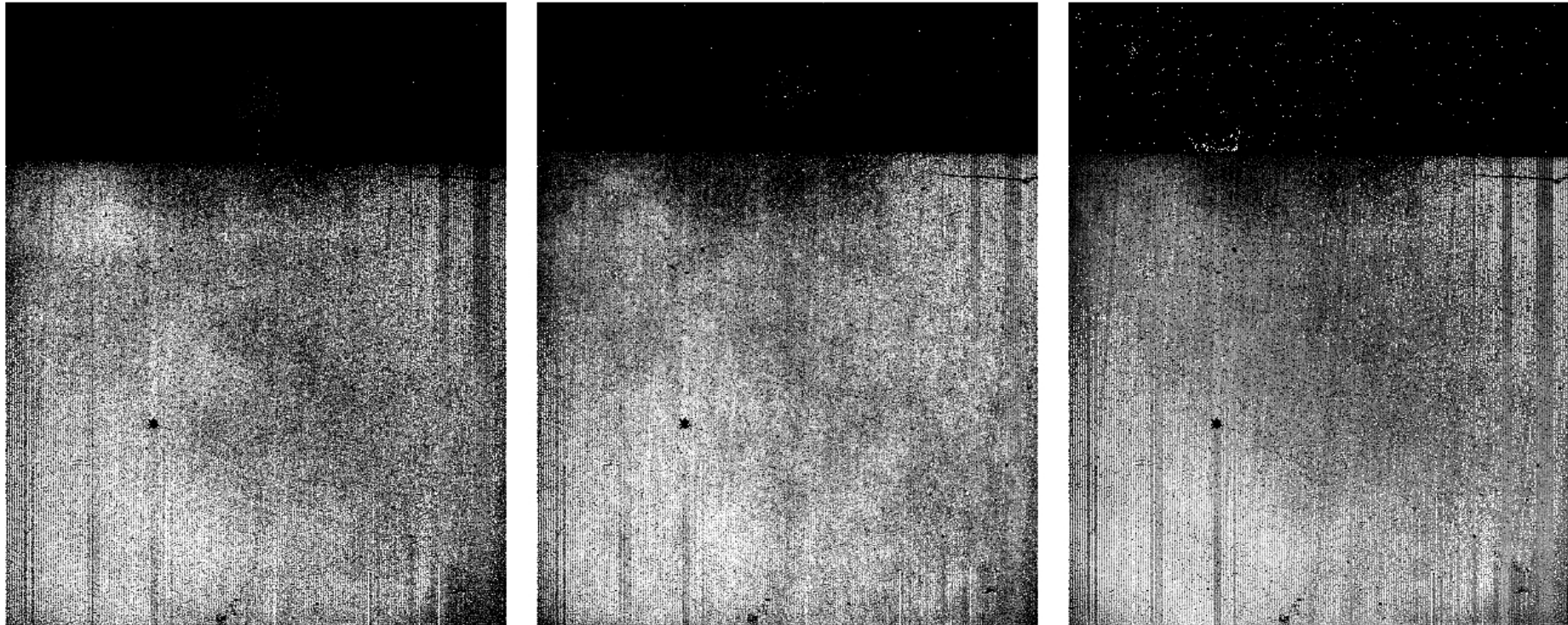




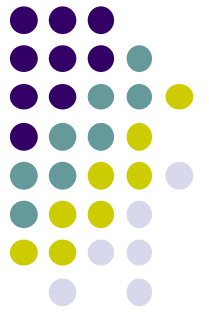
# Data quality (6)

## Flats: don't look good

N2, N3, and N4 flat images from left to the right. Displayed level: 0.95-1.05



- Flat field images
  - Made with all imaging data obtained so far in phase3
  - Will be updated in future, by using more data.



# Data quality (7)

## Short frame: Exp time ?????

- Those who use

- AOTZ0 and AOTZ4

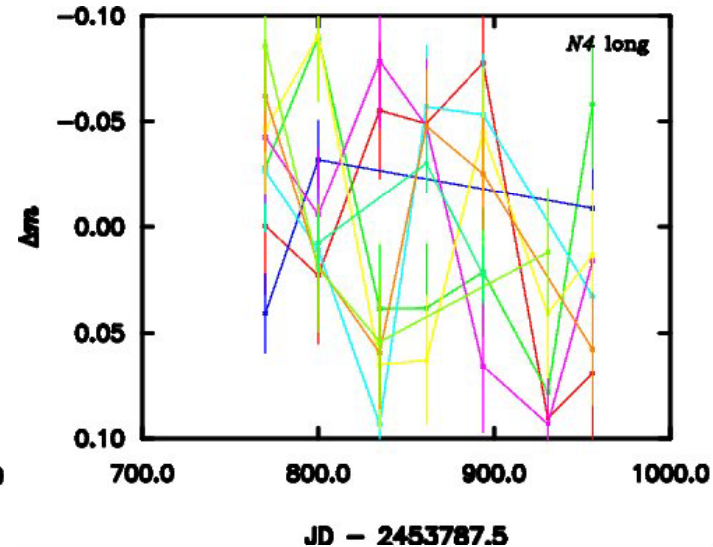
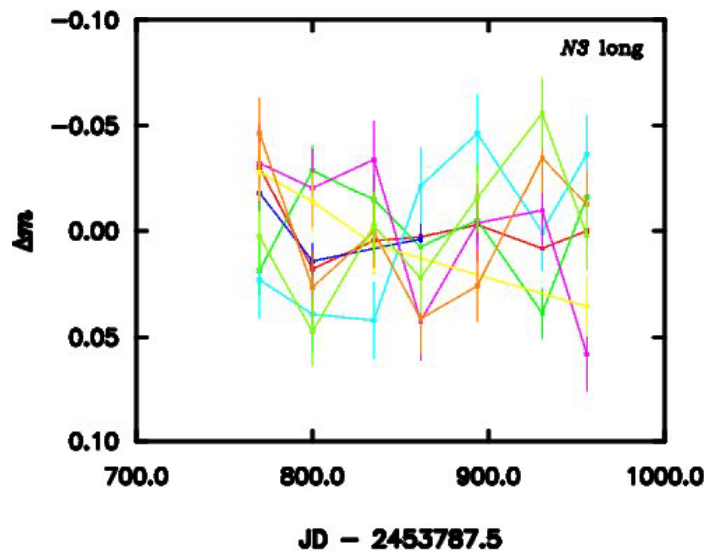
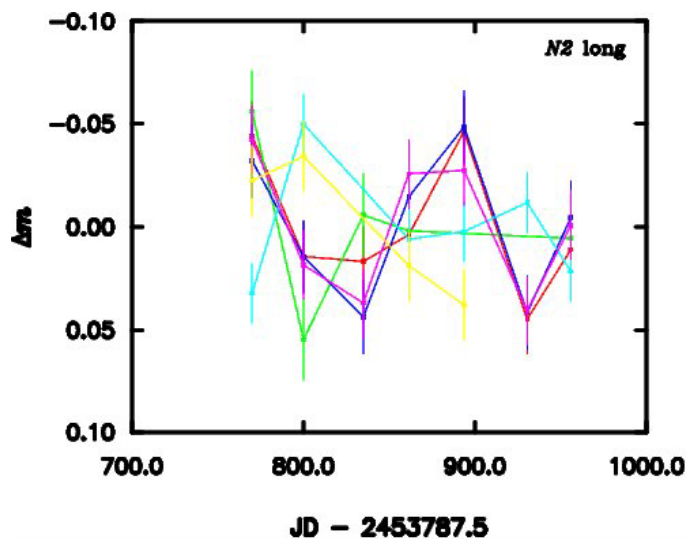
should not use short exposure data. (at now)

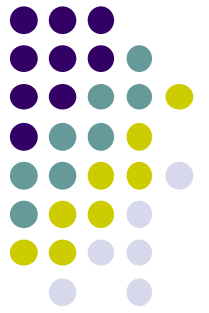
Their  $T_{\text{long}} / T_{\text{short}}$  ratio is not understood yet.



# System stability

- We monitor several stars in the CVZ
  - Using data taken in the period from Apr to Oct. 2008
  - Data provided by Dr. T. Tanabe



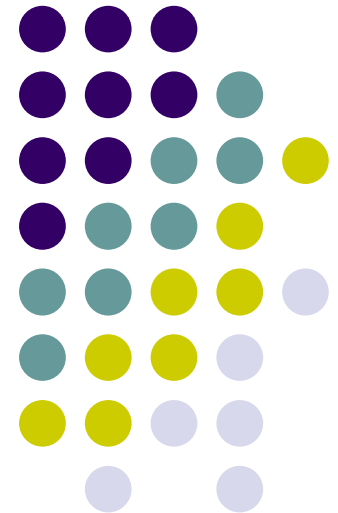


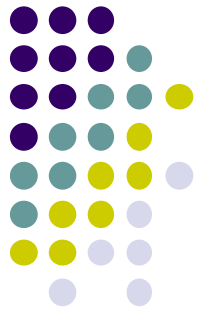
# Summary

- Analyses of phase-3 N3 image showed that
  - PSF: slightly gets worse
  - Sensitivity: gets worse by 0.7
  - Saturation limits: gets worse
    - 30 mJy -> 9 mJy @N3, long exposure
- N2 and N4 will be analyzed, although we do not expect match dependency on wavelength.
- Calibration constants (ADU -> Jy) are not supplied yet.

# Part 2: imaging pipeline for Phase3

- Requirements
- Changes from the previous version



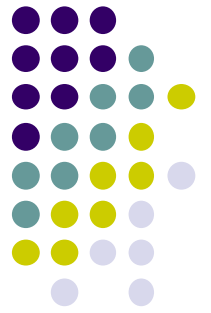


# Requirements

- Unix (Linux, BSD, OSX, Solaris)
- Perl
- GCC3.0 or later
- IRAF version 2.12.2a
  - Does not work on IRAF 2.14.
  - May work on IRAF 2.14.1 (Not fully tested).



# Changes from the previous version.



- Not significantly changed
  - Only but important change: **Handling of DARK.**
  - **Now self-dark is always used.**
    - Cf. With phase1&2 pipeline, super-dark was always used for NIR data, because there were only 2 darks.
    - In phase3, we have in total 10 independent dark images in a pointing opportunity. These dark images are combined to make a self-dark image, and then it is subtracted from each object image.
- No change in usage, nor structure of the pipeline