

Introduction of HSC instrument and observation mode : Filters, Overheads, Calibration

HSC Queue-Mode Workshop
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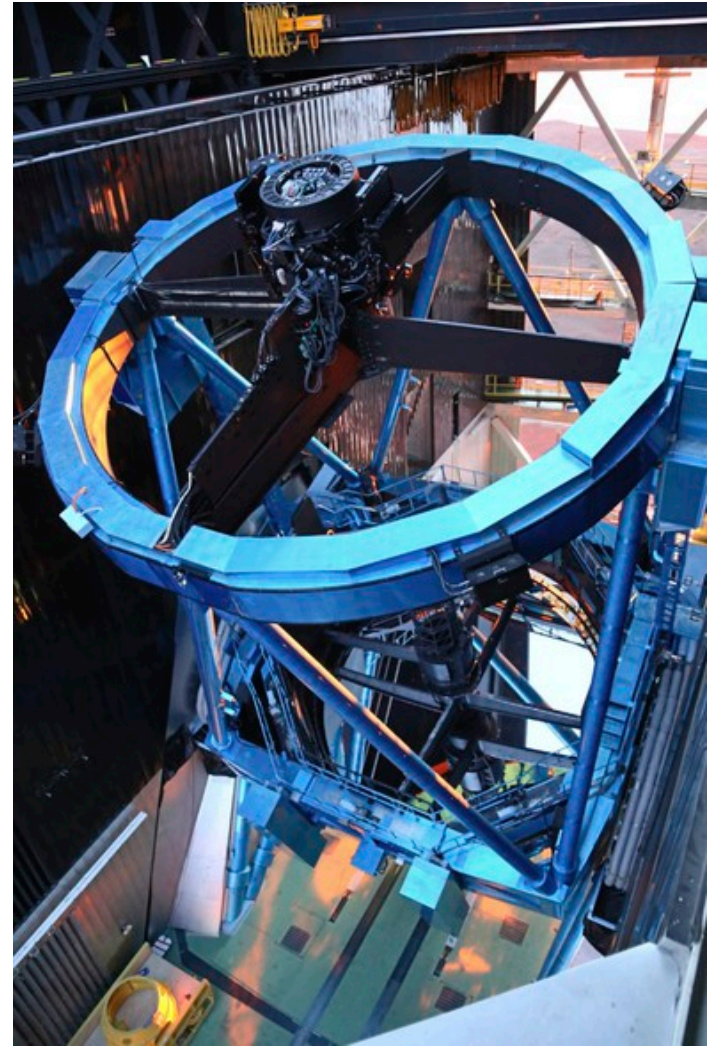
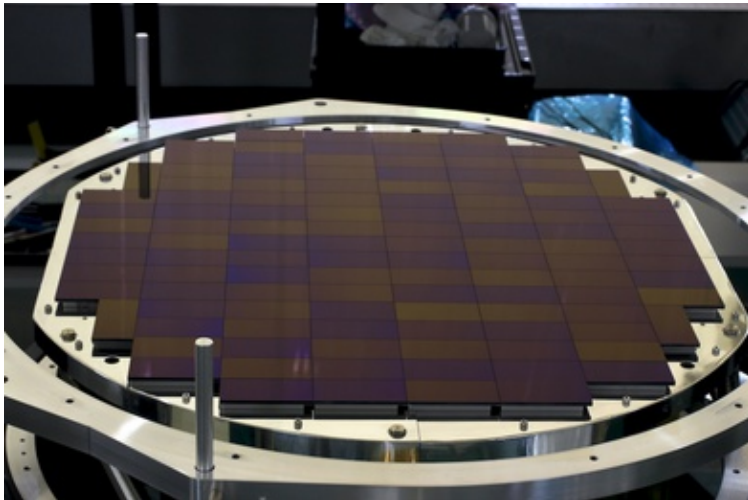
- ◆ About HSC
- ◆ Filters
- ◆ Observation mode
- ◆ Overhead

HSC

◆ Hyper Suprime-Cam

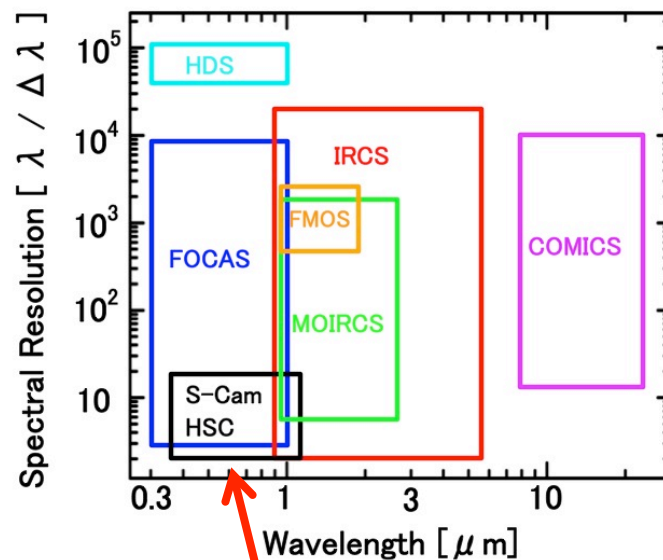
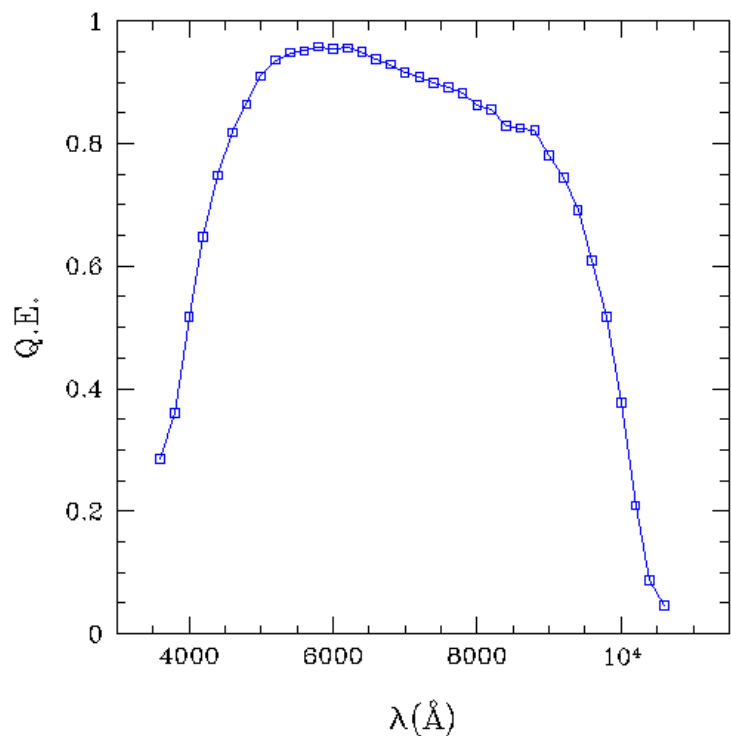
SUBARU (8.2 m) prime focus instrument

- ◆ 104 x 2k4k CCDs
- ◆ FoV 1.5deg Φ (0.17 arcsec/pixel)
- ◆ 2012/8 first light
- ◆ 2014/3- open use observation



HSC

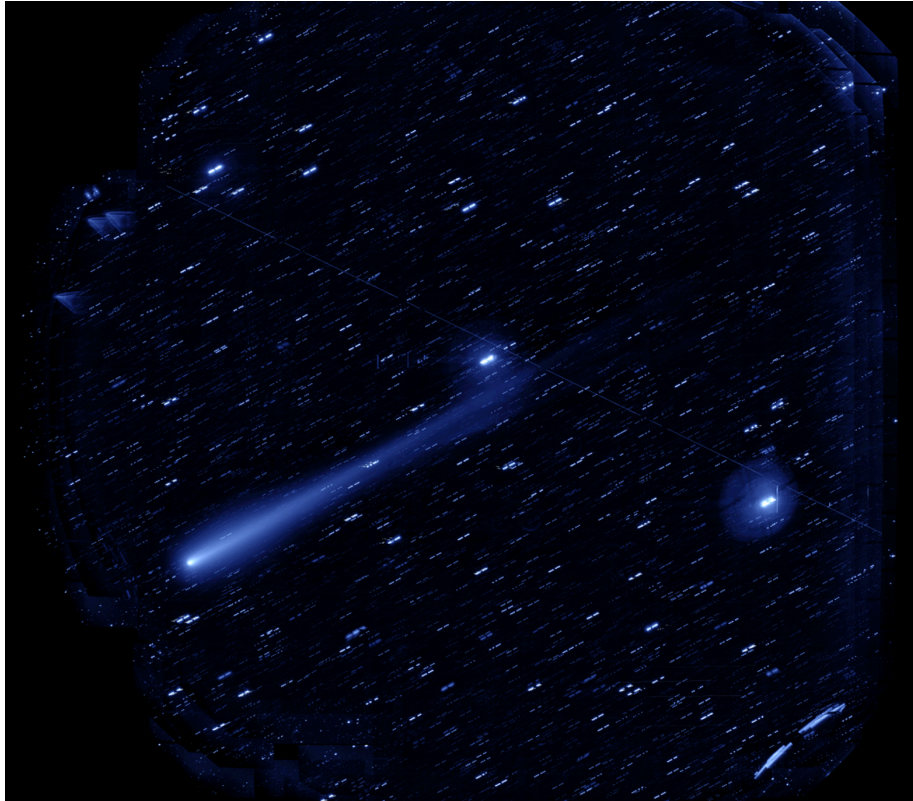
QE of CCD (Hamamatsu FDCCD)



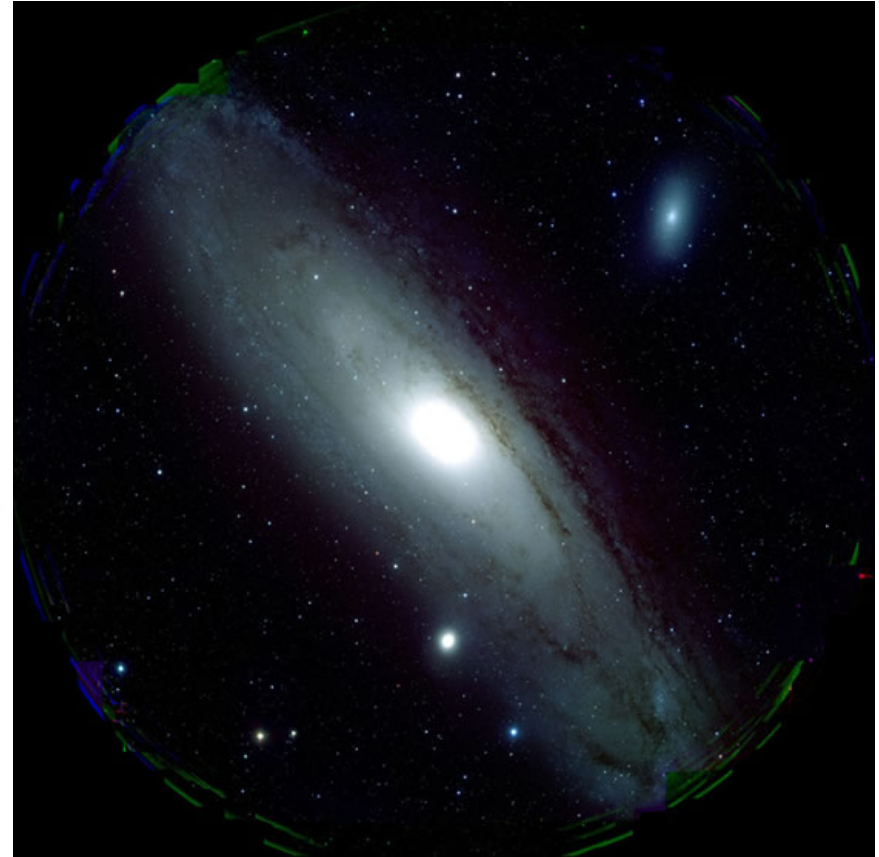
Optical camera
NO spectroscopic mode

- ◆ Wavelength: 4000Å – 10000Å
- ◆ HSC only provides an imaging mode

HSC



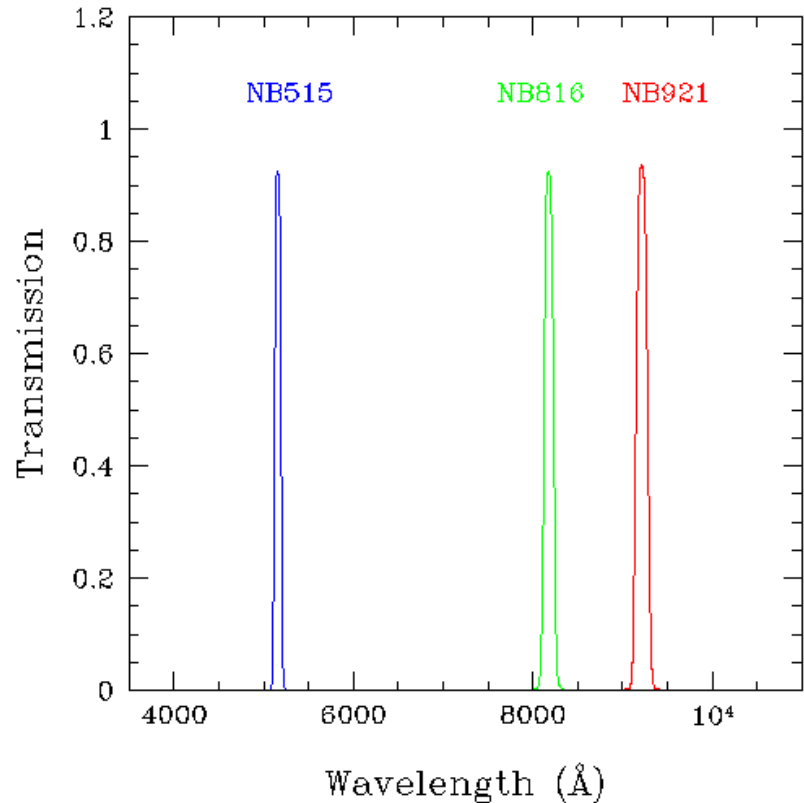
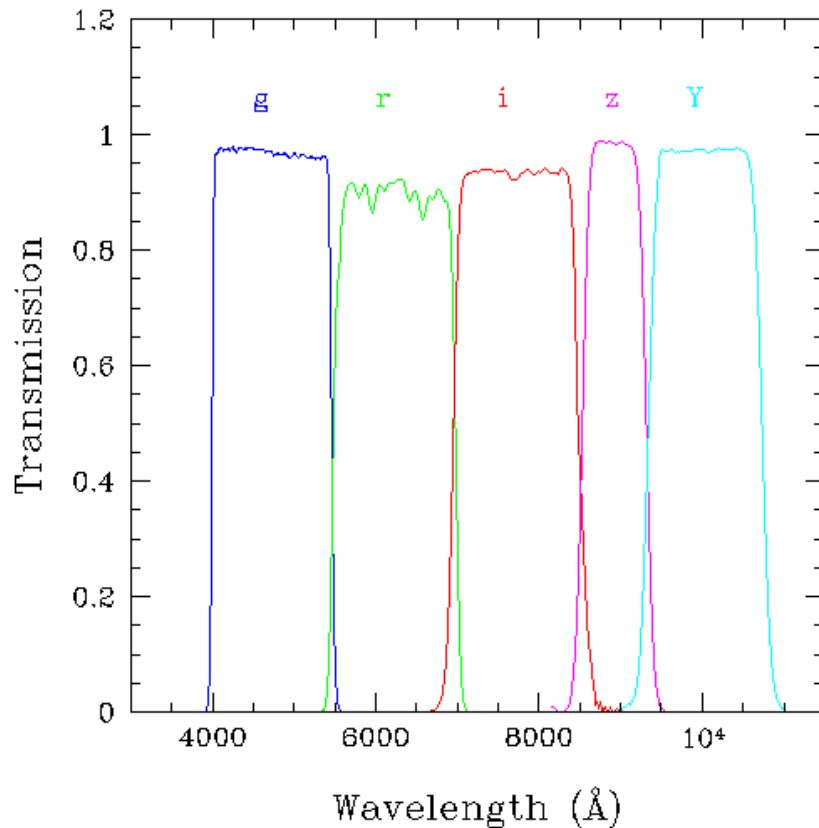
Ison comet



M31

HSC provides deep and very large FoV images.

Filters



- ◆ 5 broad-band filters (g, r, i, z, Y)
- ◆ 3 narrow-band filters (NB515, NB816, NB921)
- ◆ More narrow band filters may be opened in the near future

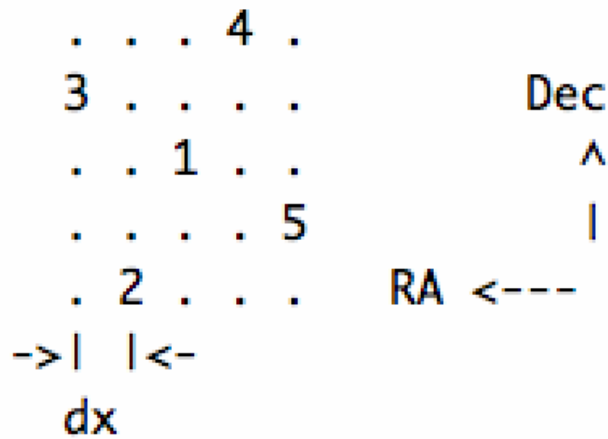
FEU

- ◆ Filter Exchanger Unit
- ◆ FEU consists of 2 stackers.
- ◆ Each stacker can store 3 filters.
- ◆ HSC can hold up to 6 filters in one observing run.
- ◆ Considering the number of broad-band filters (5; grizY), we may not be able to use many narrow-band filters within one observing run.



Observation mode for main exposures

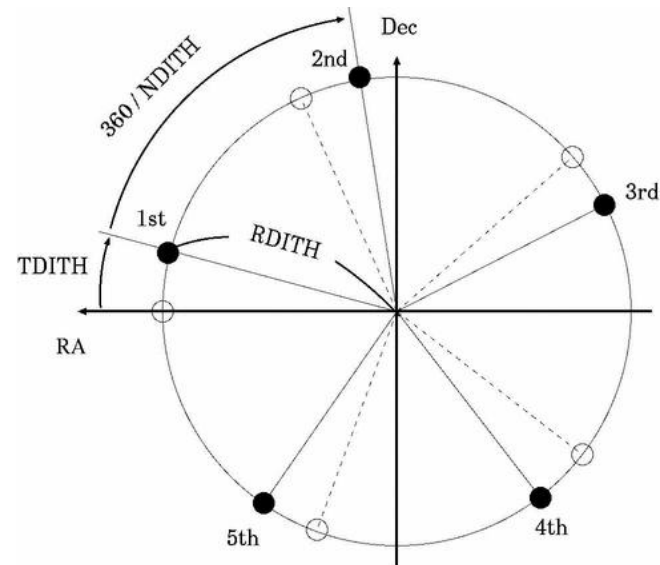
- ◆ Single shot mode
- ◆ Five-shot mode
- ◆ N-shot mode



Five-shot mode

Parameter:

DITH_RA, DITH_DEC



N-shot mode

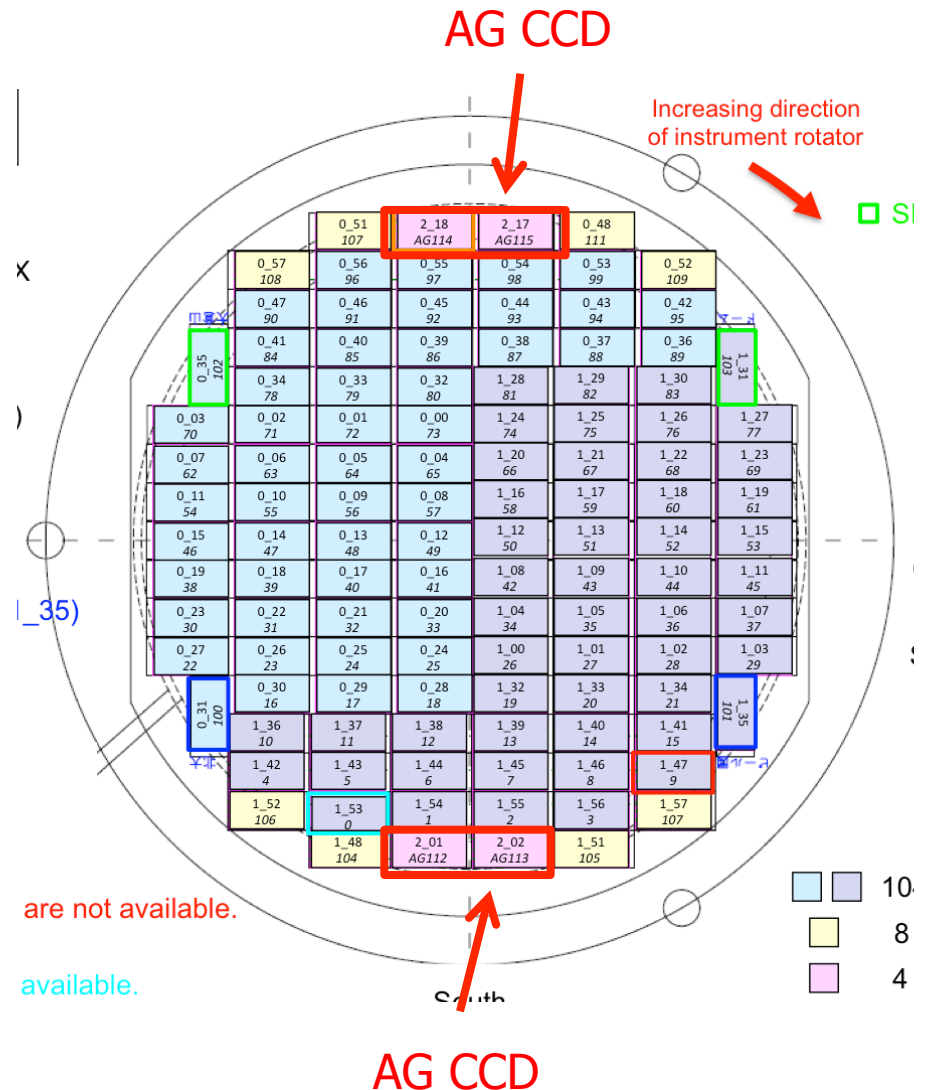
Parameter:

NDITH, RDITH, TDITH

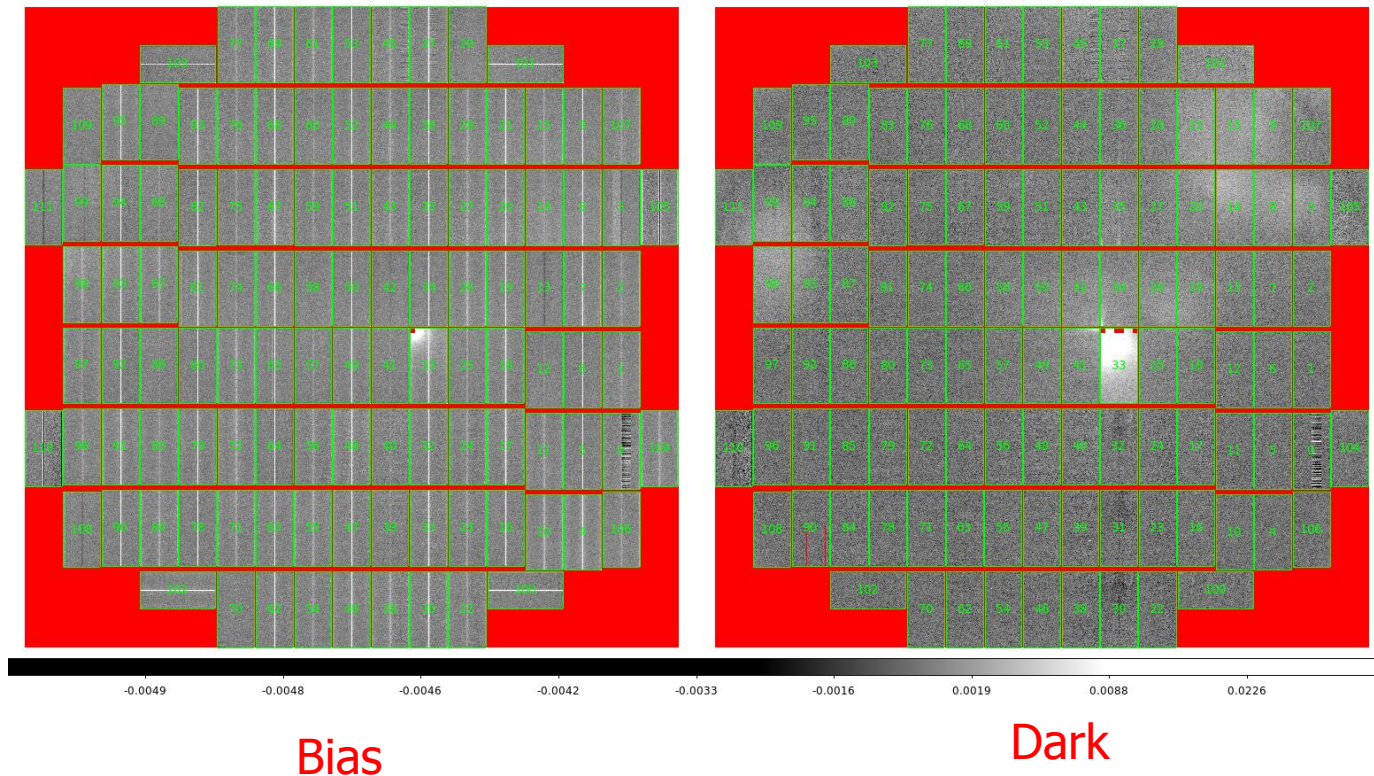
- ◆ The gaps of HSC CCDs are $\sim 12 - 53$ arcsec. We recommend that you should use dither steps of 120 arcsec or larger.

Auto Guider

- ◆ Auto guiding (AG) mode is available using 4 AG CCDs, which are inside the HSC dewar.
- ◆ AG is effective ~ 30 s after opening shutter.
- ◆ If the exposure time is over 300s, you may have better use AG.



Necessary calibration data in one observing run



- ◆ Bias x 10
- ◆ Dark 300s x 5
- ◆ Dome flats ~ 10 for all 6 filters
 - ◆ These calibration data can be shared by all observers.

Observation

◆ Preparation

- ◆ Changing filters, if necessary.
- ◆ Checking CCD status by taking some test exposures.

◆ We usually open the dome **30min** after sun set.

(If twilight flats are necessary, we will open the dome earlier.)

- ◆ ~10 min for opening the dome.
- ◆ ~5-10 min for the first focus test.
- ◆ ~1 min for taking 30s exp. of the SDSS field (photometric calibration).
- ◆ Starting main observation. (15-20min before astronomical twilight?)
- ◆ (Sky level may be still too high?)

Overhead

- ◆ Overhead: 30% of total time.
 - ◆ 1night: 10 hrs -> actual on-source time: 7 hrs
- ◆ 30s exp. of SDSS fields for photometric calibration
 - ◆ At least 3 times per one night.
 - ◆ If you need Landolt standards or spectrophotometric standards, these will be counted as your observing time. (NOT overhead)
 - ◆ We may take 30s exp of SDSS fields **after changing targets and filters.**
- ◆ Focus test ~5min
 - ◆ ~3 – 4 times per one night.
 - ◆ After changing filters, we need to do the focus test.

Overhead

◆ Filter exchanging $\sim 30\text{min}$

- ◆ Move telescope to the zenith position
- ◆ Rotate the instrument rotator to $\sim 0\text{deg}$
- ◆ Close the cover of the primary mirror

◆ Read out $\sim 40\text{s}$ (right figure)

◆ $36.3 \pm 3.6\text{s}$

(2014/7/4 – 2015/3/30)

◆ Telescope slewing time

◆ 0.5deg/s

