



Current Status of HIDES-F HR-mode

Eiji Kambe (OAO/NAOJ), 2015.09.24

history:

2009: the first-light of HE mode in December 2009 & expectations expressed for HR-mode ($R \sim 100,000$)

FY2010: development of HR-out and image slicer by the research fund from JSPS (Kakenhi Kiban A: PI Takatoshi, Kajino)

FY2011: development of HR-in by OAO internal fund

2012: [the first-light of HR-mode on April 26, 2012](#)

10 hours observation on May 7, 2012

11 hours observation on December 11–12, 2012

5 nights test observations in 2015 (on going; for exoplanet searches)

target sciences:

Li6 to Li7 abundance ratio to explore the origins of the elements

obtain stellar templates for precise radial-velocity measurements of exoplanets harbouring stars (in replace of HIDES-Slit)

Detection non-radial oscillations in Ap and other stars

...



HR-mode specifications :

Optics:

HR-in at Cassegrain focus:

FOV ϕ 1.52", converting F-ratio (F18→F4.8) and making
an pupil image at the fiber input end with a microlens

optical fiber cable: Polymicro Inc. Co. FBP070-084-095

HR-out at Coude focus (entrance of HIDES)

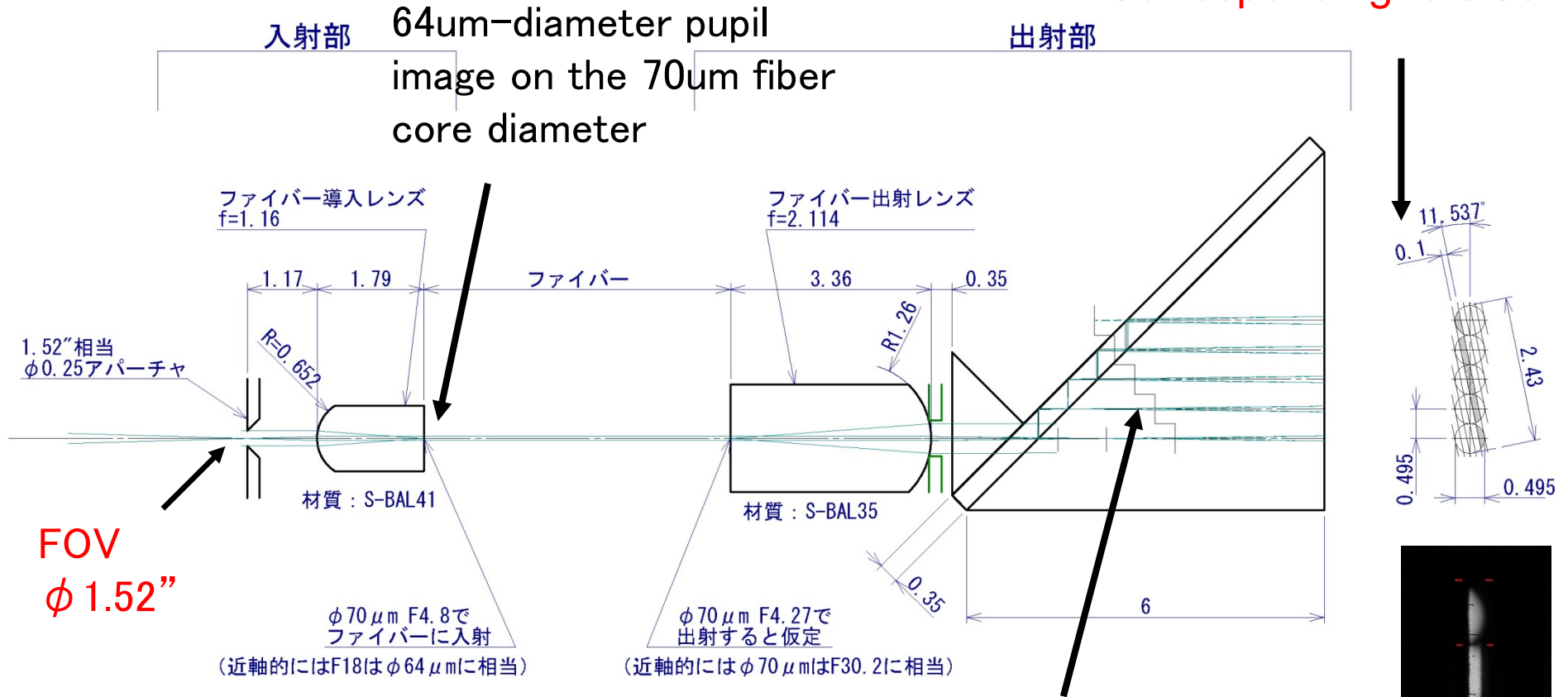
converting F-ratio (F4.3→F29), making an star image at the
fiber output end , and then **slice the image into five components**
by an image slicer

HE-mode and HR-mode can be exchanged remotely

Sharing the calibration unit, the auto guider, the user interface (GUI)
with HE-mode

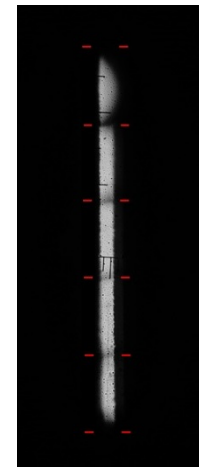
Optics of HR-mode

R~100,000
Corresponding to 0.38"

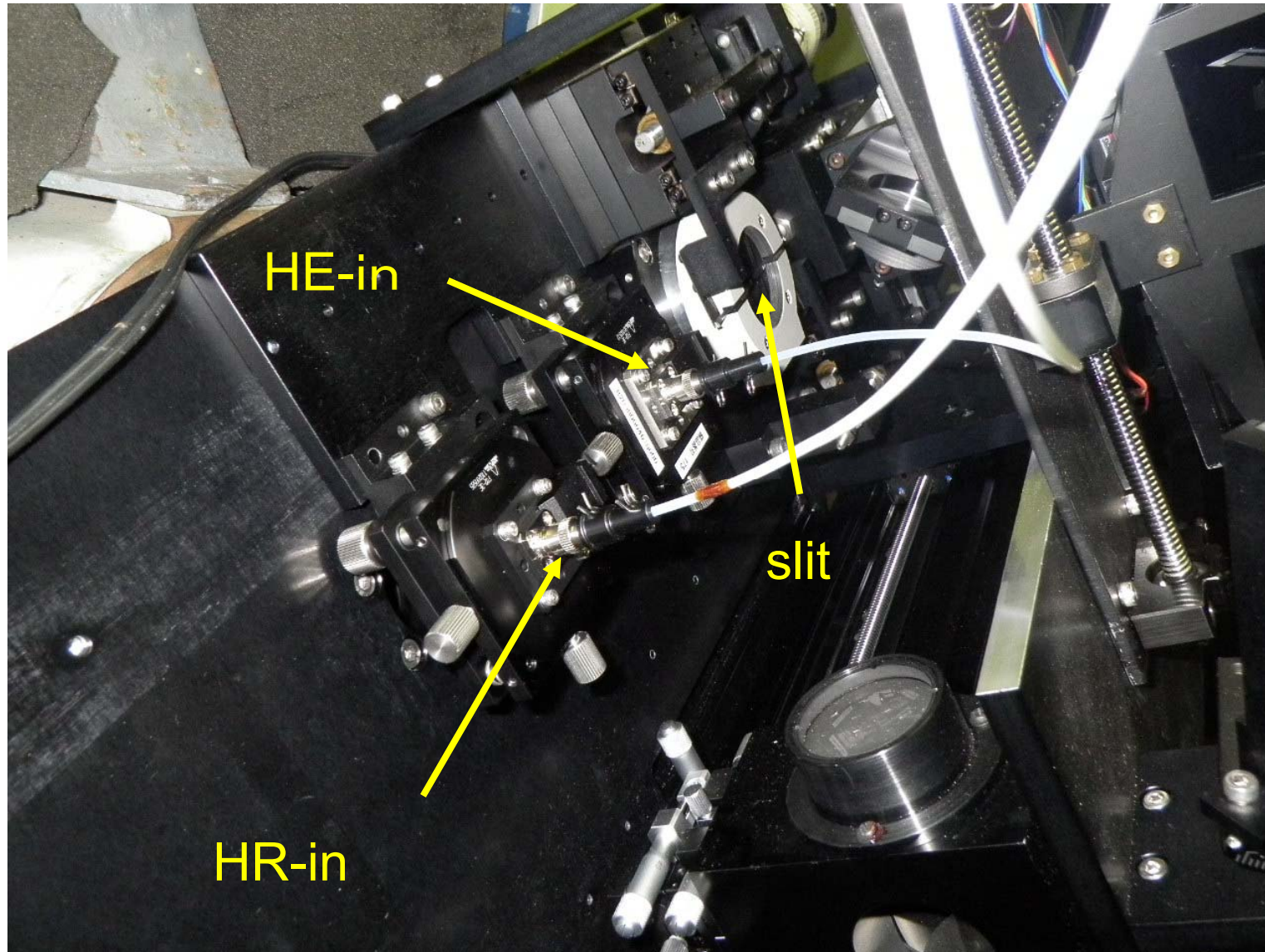


five slices of 1.88" star image (considering FRD)

similar optics but smaller components relative to those of HE-mode



at coude focus (entrance of HIDES)



Summary of preliminary performances of HR-mode:

wavelength resolution: $R \sim 113,000$ (2 pixel) corresponding to 0.38''

$R \sim 122,000 @ 550 \text{ nm}$ as optical performance

observable wavelength region:

> 430 nm with the red cross disperser (sufficient inter-order gaps)

no limitation with the blue cross disperser

total throughput: ? %

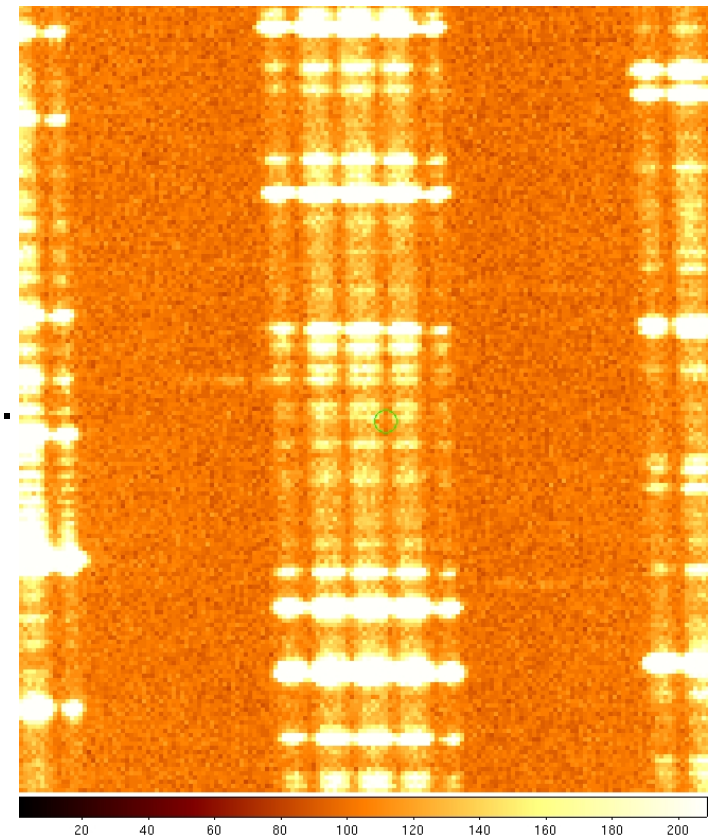
at least **4.4% @ 550 nm**

slightly lower efficiency at blue wavelength region compare to HE-mode ?

S/N: can be reached to 1,000 for < 700 nm.

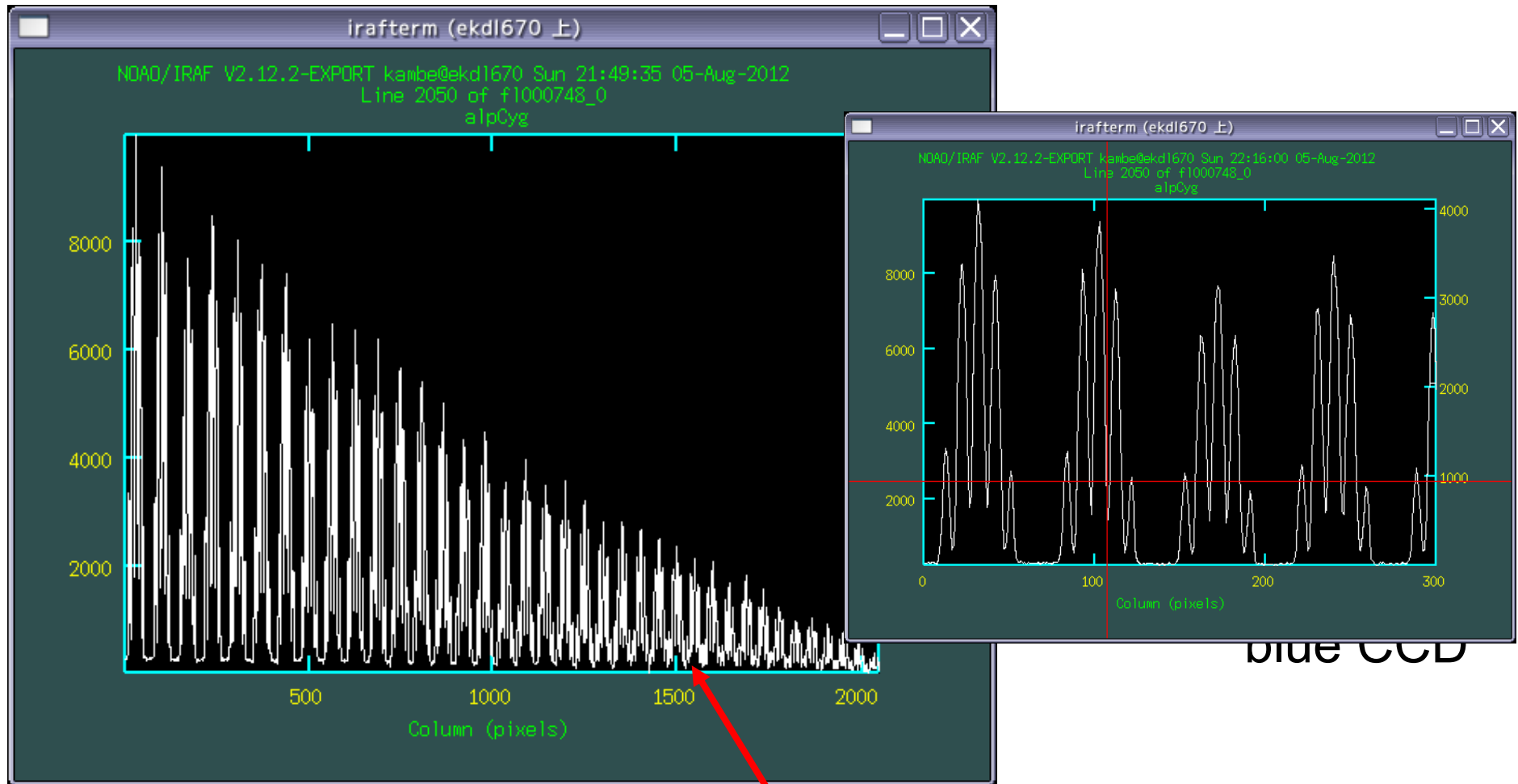
for higher S/N, an fiber agitator may be developed

Th-Ar spectral image obtained with HR-mode. One order is sliced into 5 components



observable wavelength region: $\lambda > 430$ nm for red cross disperser

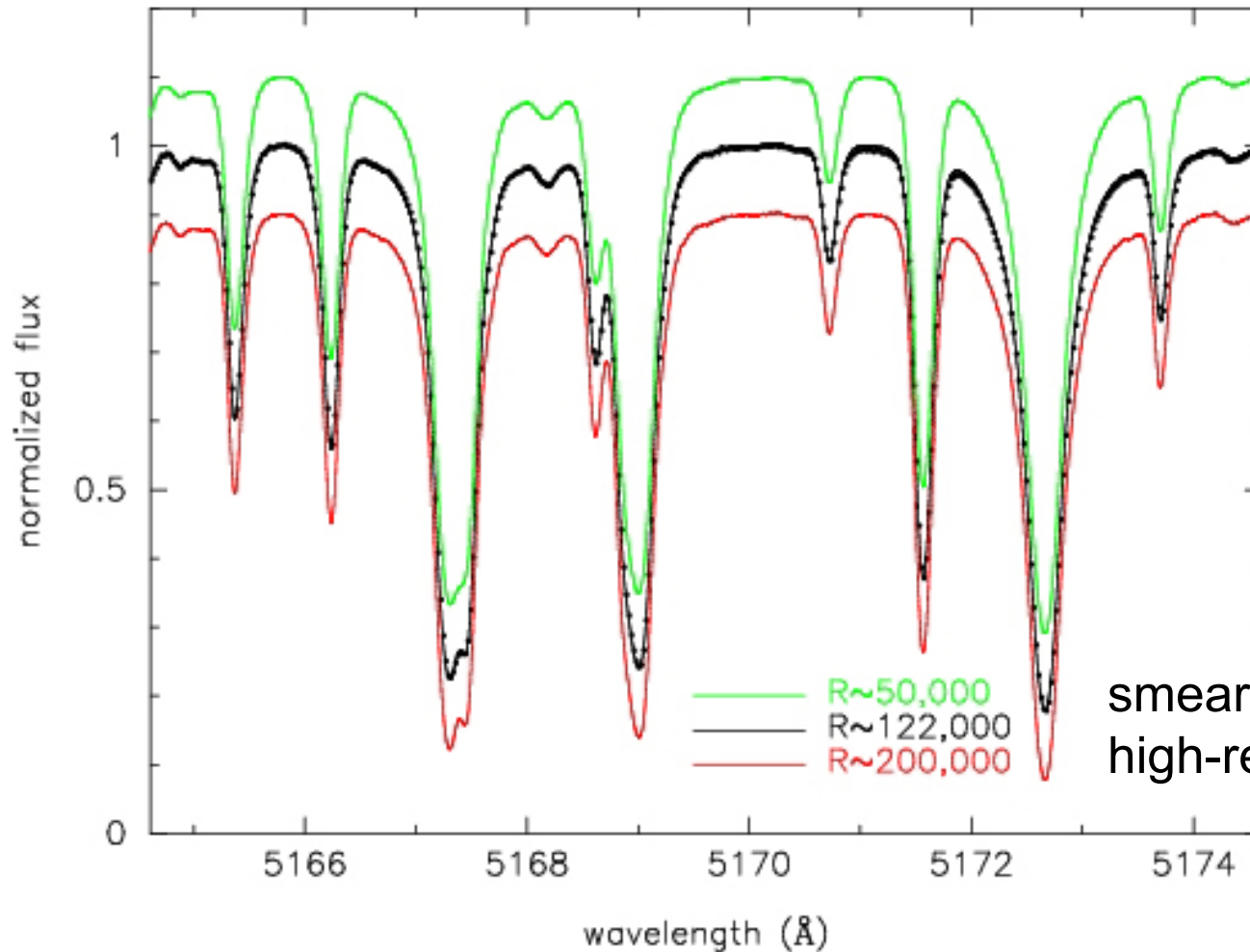
It may not be easy to remove scattered lights for $\lambda < 430$ nm



Adjacent echelle orders overlaps at around 410 nm

Wavelength resolution: $R \sim 113,000$ (2 pixel) corresponding to $0.38''$
 $R \sim 122,000 @ 550 \text{ nm}$ as optical performance

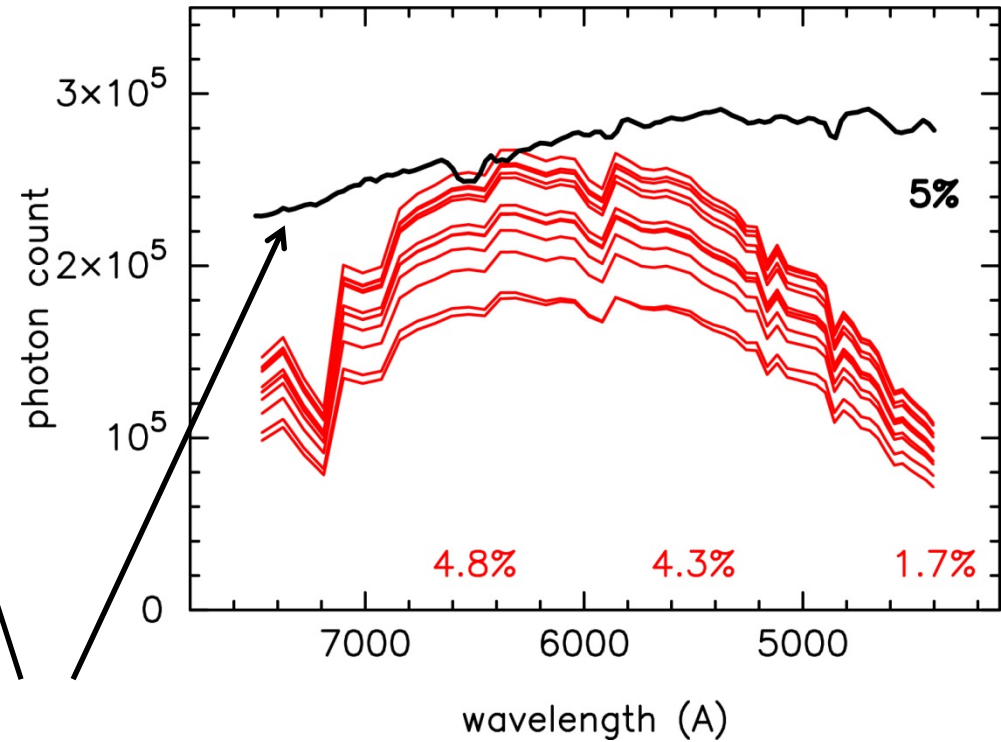
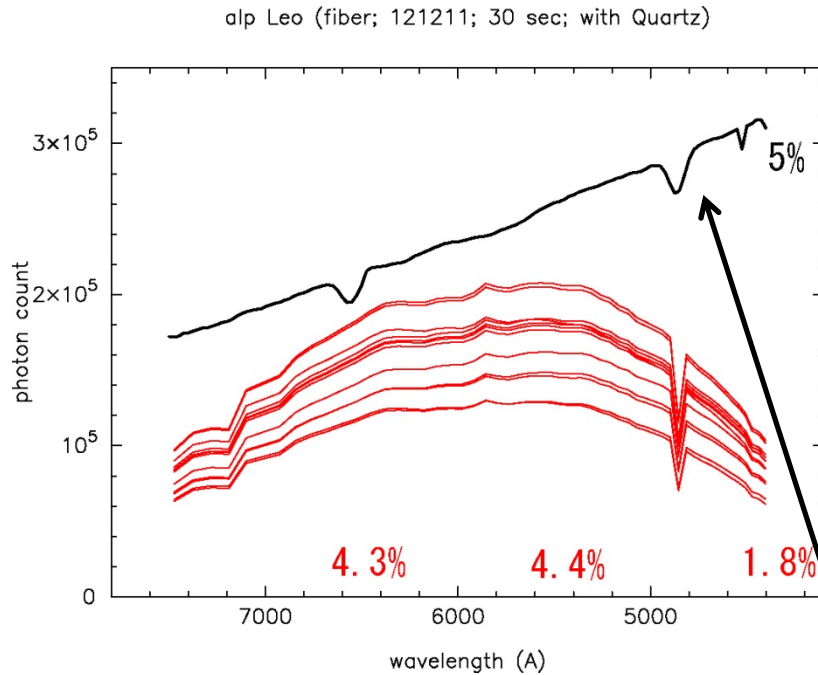
alpCMi by HR-mode (2012.4.26)



smearing the McDonald very high-resolution spectrum

examples of total throughput and its color dependence

alp Cyg (fiber 150718; per 30 second)



from Alekseeva+ 1996, 1997

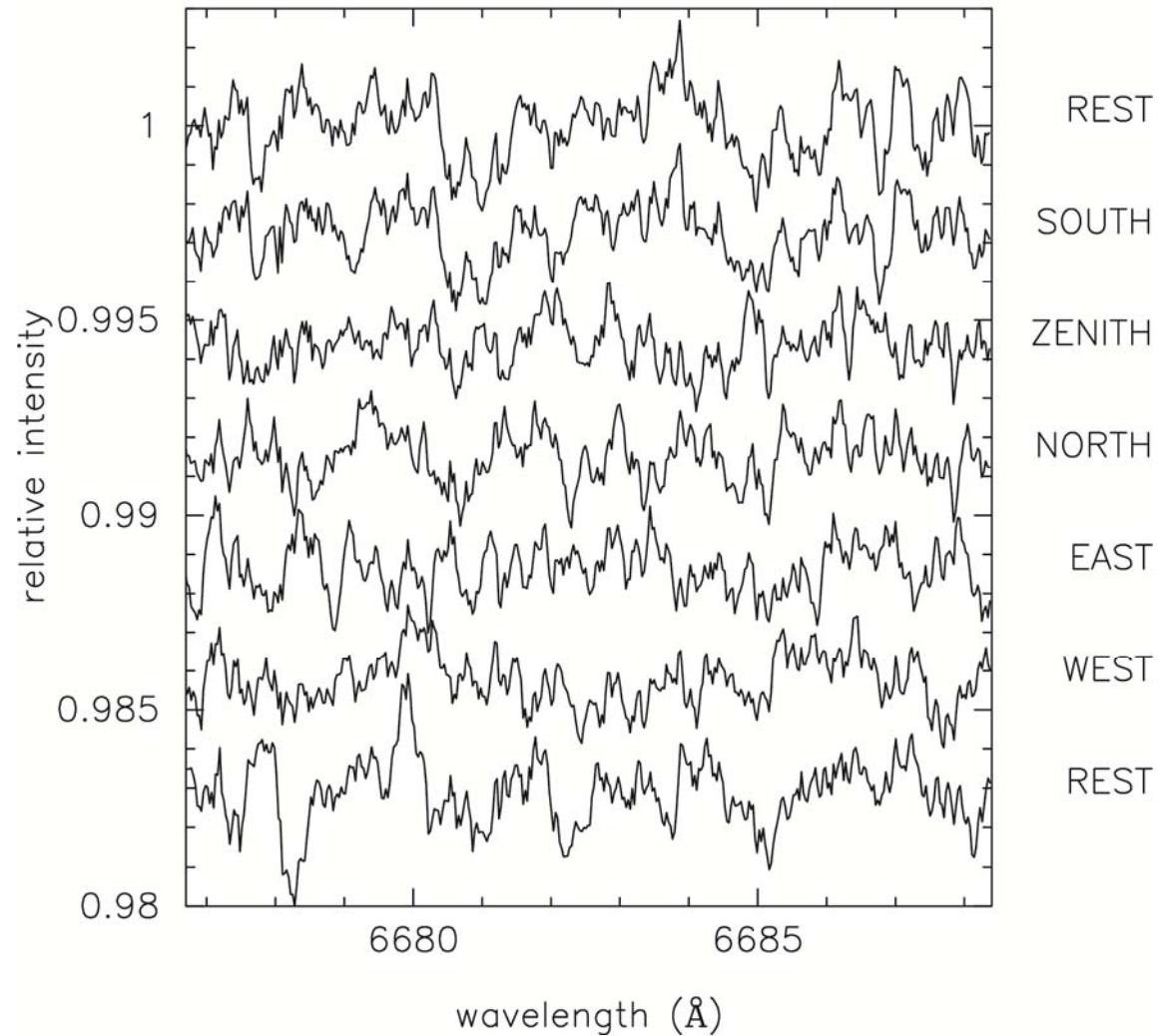
seeing size $\sim >1''$

so far, peak efficiency is about **4.4% @ 550nm**
(no excellent night yet)

- modal noise

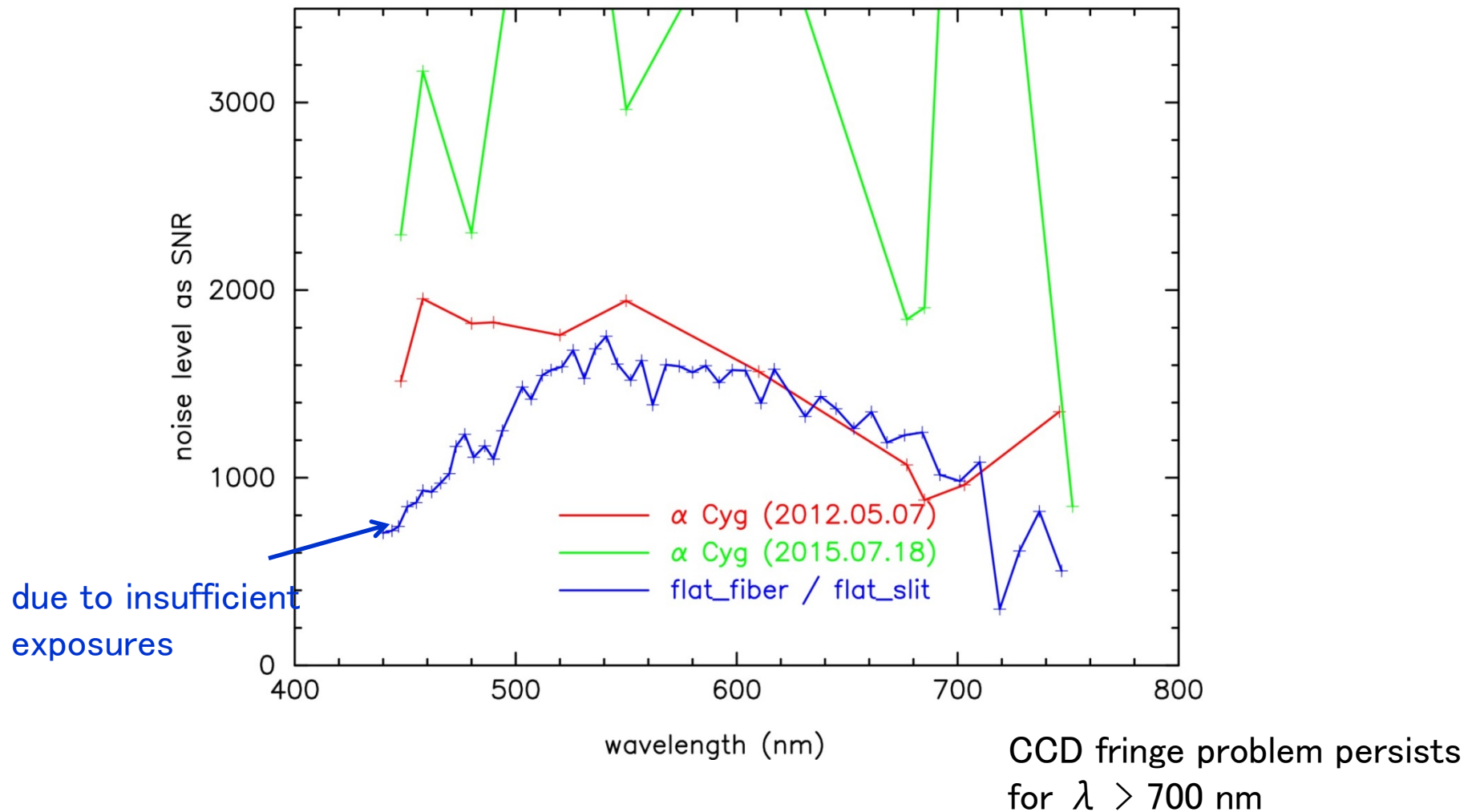
flat_fiber / flat_slit spectra obtained in various telescope directions

flat spectra in various telescope directions
– 2012.04.26 –



- estimation of unknown error sources (possibly modal noise)
not critical for $S/N \leq 1,000$ and $\lambda < 700$ nm

unknown error source (modal noise ?)





Plans and Tasks:

- * improvement of auto guider *more sensitive than HE-mode*
- * further evaluation and improvement of throughput
 - the cause of less efficiency at bluer wavelength
 - replacement of optical components (e.g. microlens) ?
- * for higher S/N
 - developing fiber agitator
- * toward queue observations
- * continue test observations *2015B (2 nights)*

will open as a risk-shared PI type instrument at 2016A