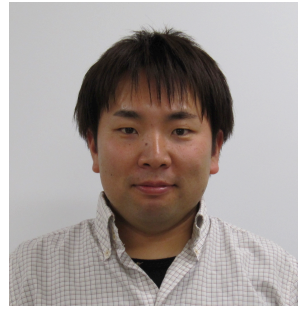


Subaru Telescope 20th Anniversary  
-Optical & Infrared Astronomy for the Next Decade-  
Nov. 17 - 23 2019, Hawaii

Masashi Omiya, IRD-SSP team  
1. Astrobiology Center (ABC), NINS 2. NAOJ



# Precise radial velocity survey of late-M dwarfs in IRD-SSP: Observation status

Infra**R**ed **D**oppler for the Subaru telescope  
**S**ubaru **S**trategic **P**rogram

# Goals of IRD-SSP survey

- Exploring habitable-zone(HZ) Earth-like planets
  - Earth-mass planets of  $P < 100$  d
- Uncovering population of planets beyond snow line
  - Giant planets of  $P < 1000$  d beyond the snow line
- Uncovering population of close-in low-mass planets
  - Super-earths of  $P < 300$  d

# Goals of S19A observation

- RV stability test

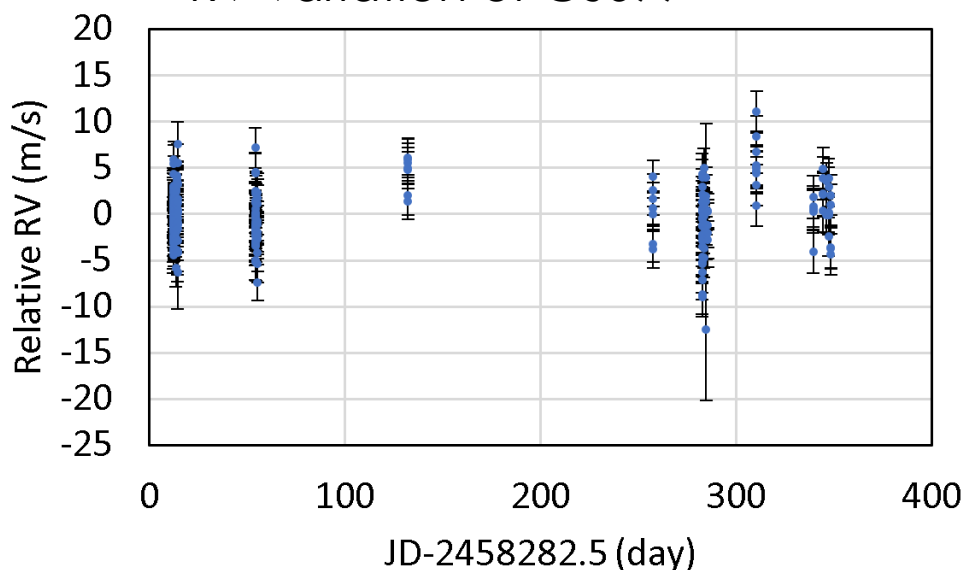
- RV standard stars (GJ699, GJ1002, Teegarden's star)
- Planet harboring star (GJ436)

- Screening for target candidates

- Long period binary (Visual binary)
- Spectroscopic binary with double line (SB2)
- Rapidly rotating (active) stars
- Spectroscopic binary with single line (SB1)

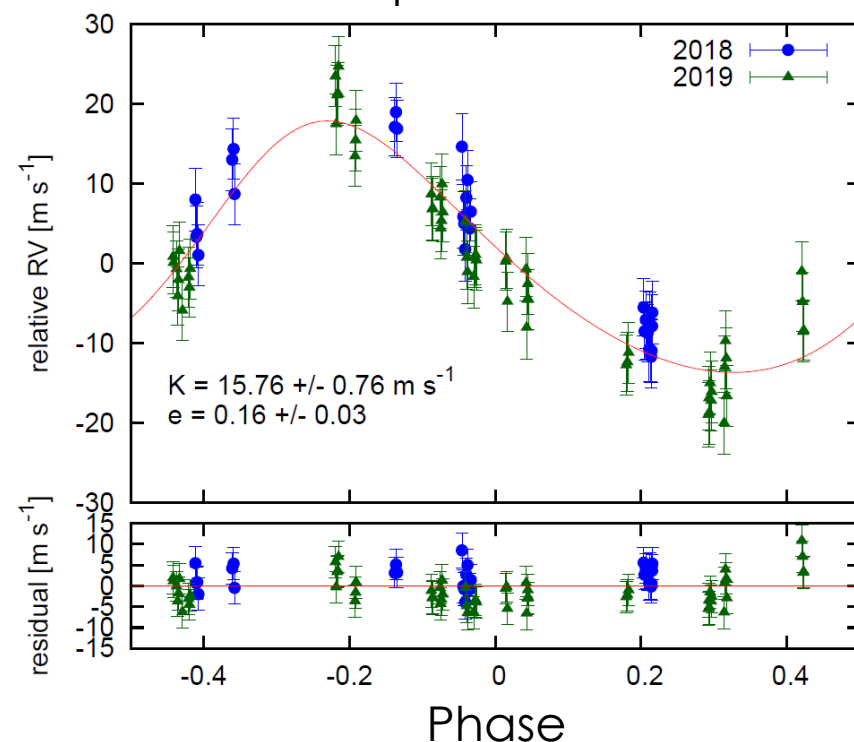
# RV stability test using standard stars

RV variation of GJ699



Total error	Internal error	Instrument + Activity error
2.96 m/s	2.13 m/s	2.06 m/s

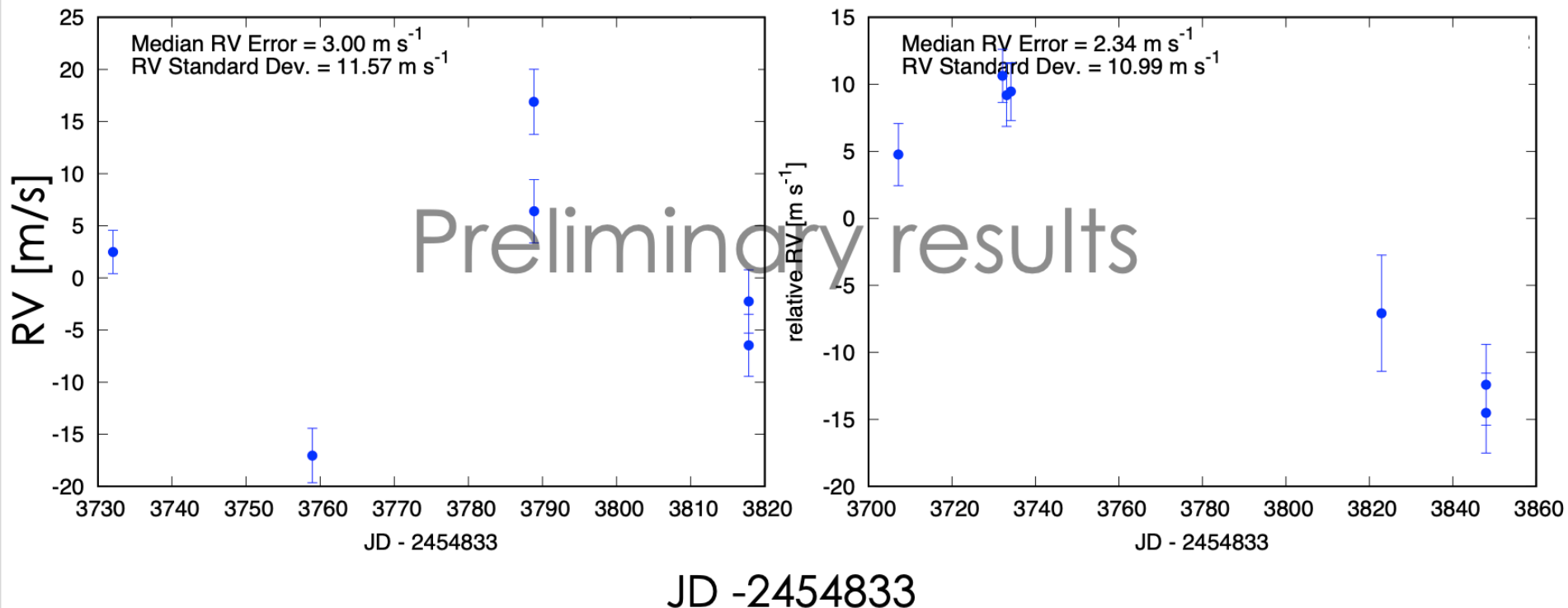
RV variation of a planet host star GJ436



	IRD	Knutson et al. 2014 HIRES	Trifonov et al. 2018 HARPS, HIRES, CARMENES
K (m/s)	$15.76 \pm 0.76$	$17.01 \pm 0.54$	$17.38 \pm 0.17$
e	$0.163 +0.033-0.026$	$0.1495 +0.016-0.0097$	$0.152+0.009-0.008$
$\varpi$ (degree)	$326 +17-13$	$336 +12 -11$	$325.8+5.4-5.7$
Number of data points	90	113	638

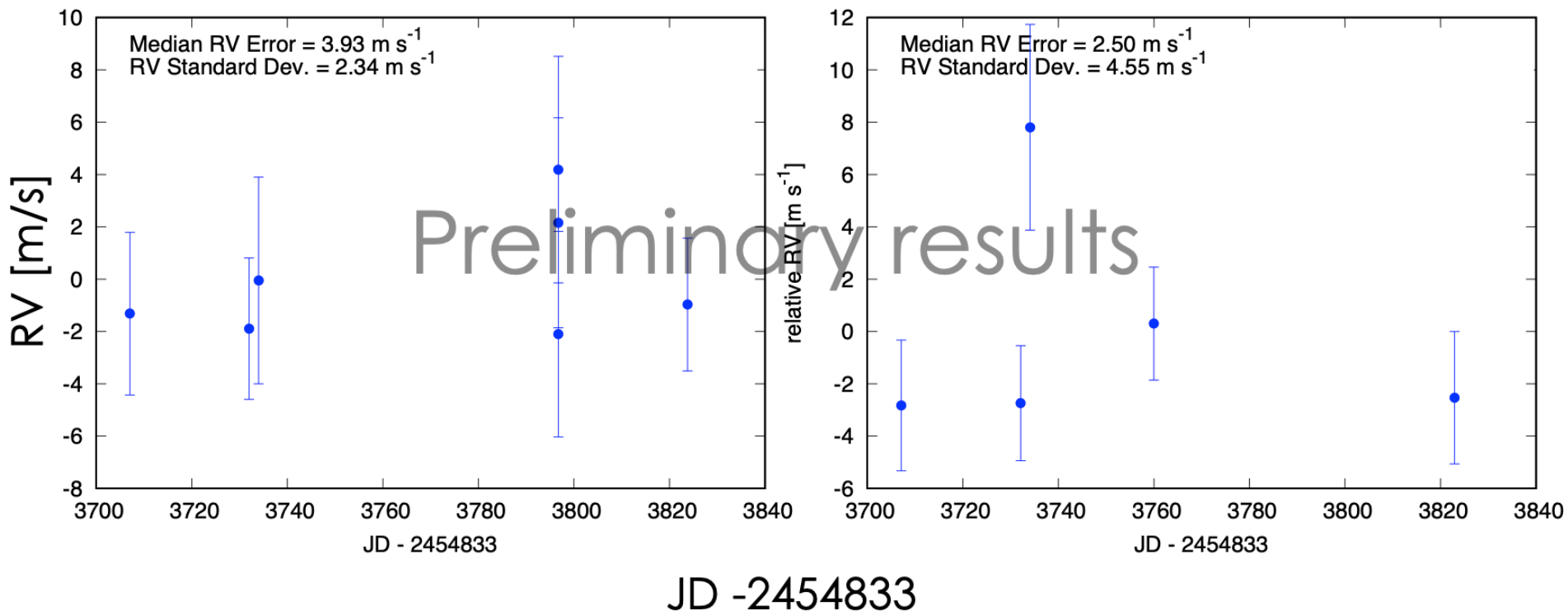
# RV analysis of sample stars

- We performed RV analysis of 11 stars with 4 time observation.
- Target candidates : 5/11 stars
- **Planet candidates (moderate or jitter) : 3/11 stars**
- RV trend (long-period planets?) : 2/11 stars



# RV analysis of sample stars

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# Screening to exclude unsuitable stars

## AO imaging

IRD FIM images (with AO188)  
of visual binary



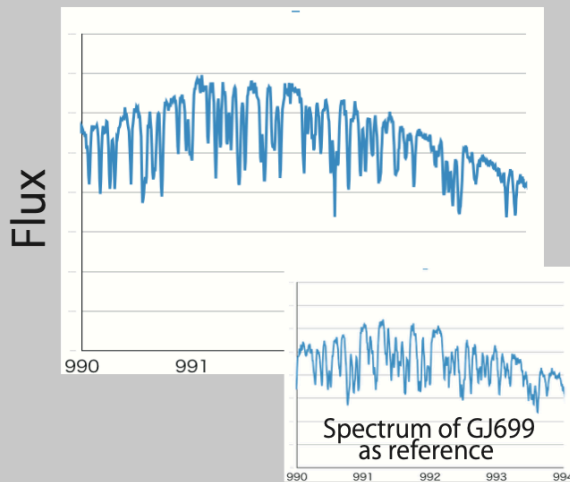
AO images taken by IRD  
Fiber Injection Module (FIM)



We found 4 visual binaries  
in the observations S19A.

## Spectral shape

IRD one order spectrum  
of double line? star



Wavelength (um)

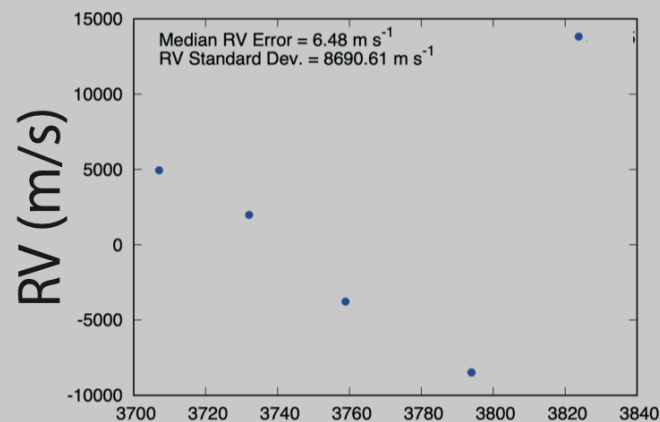
Quicklook of IRD spectra



We found 2 stars with  
double lines or line broadening

## RV observations

RV curve of SB1 candidate



JD -2454833

4 RV data points



We checked RV variations  
and found 1 SB1.

# IRD-SSP START

## Summary

- **IRD observation started in 2017**
  - IRD first light : Aug. 2017 Spectrograph) Feb. 2018 (all)
  - **IRS-SSP : START in 2019 Feb., END in 2024**
- **IRD-SSP → Large Radial Velocity(RV) survey of late-M dwarfs using Subaru + IRD**
  - Sample : ~50 late-M dwarfs (M4-M7, inactive,  $0.1-0.25 M_{\text{SUN}}$ , <20pc)
  - **Detection : >50 planets & >2 Earth-like planets in Habitable zoon**
- The proposal was accepted, started to perform preliminary results !
  - **If you are interested in IRD-SSP, please join us !**
  - Please contact to my e-mail address (omiya.maashi@nao.ac.jp)
    - Please check our proposal on web