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

**InfraRed Doppler** for the Subaru telescope

**Subaru Strategic Program**
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**

<table>
<thead>
<tr>
<th>JD-2458282.5 (day)</th>
<th>Relative RV (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>100</td>
<td>15</td>
</tr>
<tr>
<td>200</td>
<td>10</td>
</tr>
<tr>
<td>300</td>
<td>5</td>
</tr>
<tr>
<td>400</td>
<td>0</td>
</tr>
</tbody>
</table>

**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**

- **K** = 15.76 ± 0.76 m/s
- **e** = 0.163 ± 0.026
- **ω** (degree) = 326 +17-13
- Number of data points = 90

<table>
<thead>
<tr>
<th></th>
<th>IRD</th>
<th>Knutson et al. 2014 HIRES</th>
<th>Trifonov et al. 2018 HARPS, HIRES, CARMENES</th>
</tr>
</thead>
<tbody>
<tr>
<td>K (m/s)</td>
<td>15.76 ± 0.76</td>
<td>17.01 ± 0.54</td>
<td>17.38 ± 0.17</td>
</tr>
<tr>
<td>e</td>
<td>0.163 +0.033-0.026</td>
<td>0.1495 +0.016-0.0097</td>
<td>0.152+0.009-0.008</td>
</tr>
<tr>
<td>ω (degree)</td>
<td>326 +17-13</td>
<td>336 +12 −11</td>
<td>325.8+5.4-5.7</td>
</tr>
<tr>
<td>Number of data points</td>
<td>90</td>
<td>113</td>
<td>638</td>
</tr>
</tbody>
</table>
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
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- **Target candidates**: 5/11 stars
- **Planet candidates** (moderate or jitter): 3/11 stars
- **RV trend** (long-period planets?): 2/11 stars

Preliminary results
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

Quicklook of IRD spectra

We found 2 stars with double lines or line broadening

**RV observations**
RV curve of SB1 candidate

RV data points

We checked RV variations and found 1 SB1.
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 zone

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