

**Search for Extrasolar Planets around
Intermediate-Mass Stars:**

**Precise Radial Velocity Measurements
of Late-G Giants**

佐藤文衛 (東大理/OAO)

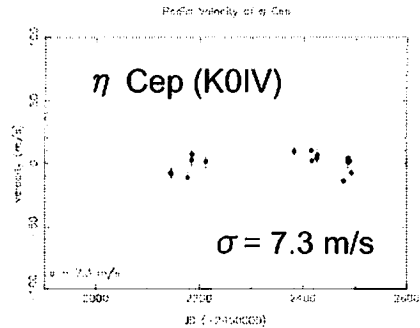
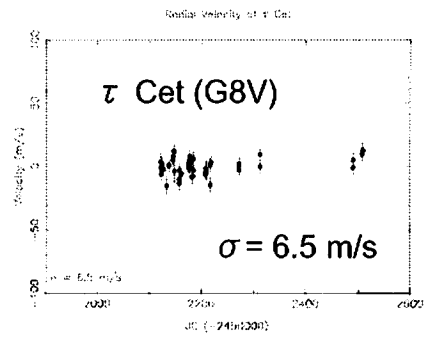
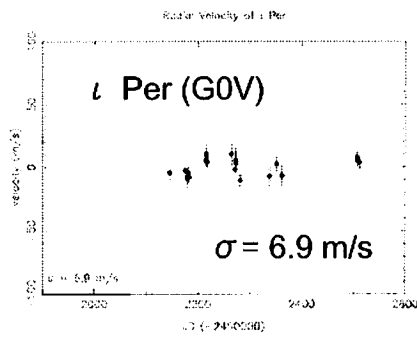
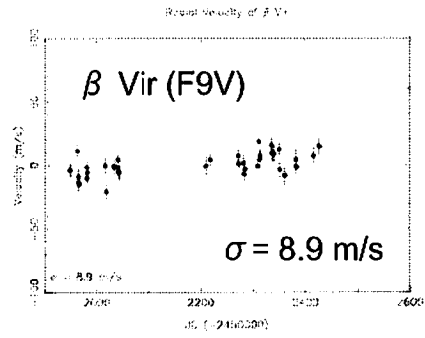
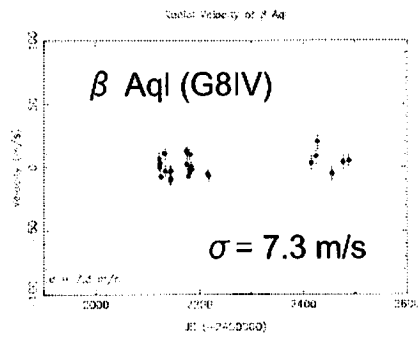
Precise Doppler Measurements with HIDES

Current Status

- We have achieved a Doppler precision of 5-6 m/s over a time span of 1 yr with HIDES (S/N>200 solar-type star).
- Current precision is probably limited by an accuracy of modeling technique of IP and stellar template spectrum.

Doppler Precision Test (1)

Standard Stars (Solar-type Stars)

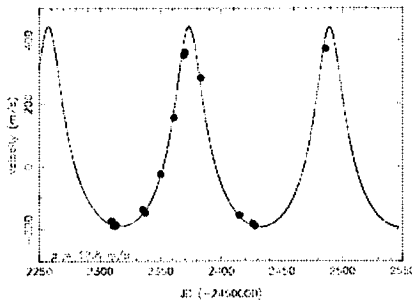


Doppler Precision Test (2)

Planet-harboring Stars

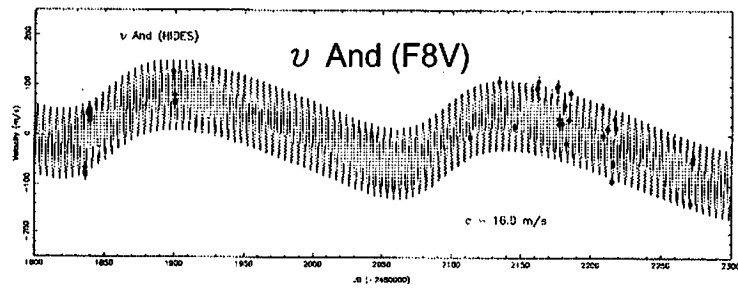
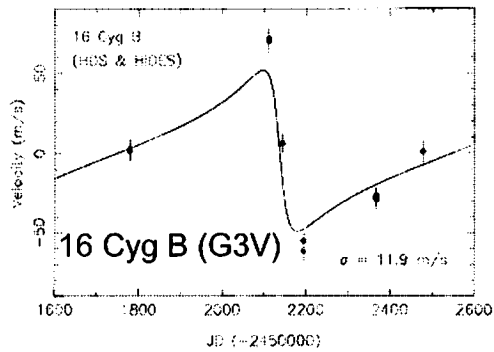
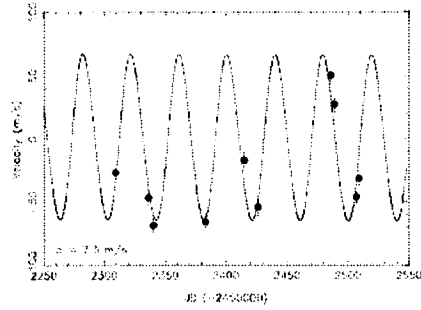
70 Vir (G4V)

Radial velocity of 70 Vir



ρ CrB (G0Va)

Radial velocity of ρ CrB



Doppler Survey of Intermediate-Mass Stars: Late-G Giants

Planets around Intermediate-Mass stars (2-3 M_{sun})

- No planets have been found yet.
 - large $v \sin i$ on the M.S. → Doppler technique ×
- Herbig Ae/Be stars and Vega-like stars
 - circumstellar disk → proto-planetary system ?
 - life time of disk <10 AU : 10^6 -7 yr
 - radiatively cleared or accreted into planetesimals

Evidence for planets around these massive stars would constrain the timescale of planet formation.

Program Stars

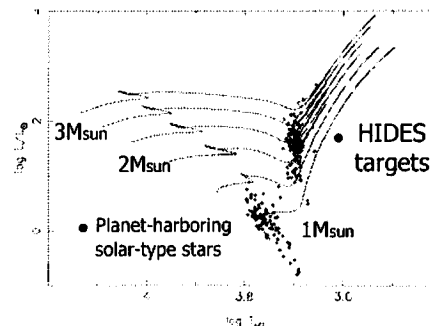
Late-G Giants

- $0.8 < B-V < 1.0$
- $-0.5 < M_V < 2.0$

Stable in rv. and phot.

$$\sigma_{rv} < 20 \text{ m/s}$$

$$\sigma_{\text{phot}} < 5 \text{ mmag}$$



Observation

2001.7 ~ (3-5 nights/month)

- In the first year, we mainly observed 60 stars in our sample ($V < 6$, totally 180 stars).
- Each star was observed at least 5 or 6 times.
- Doppler analysis for these stars is finished (Preliminary results).

Preliminary Result (1)

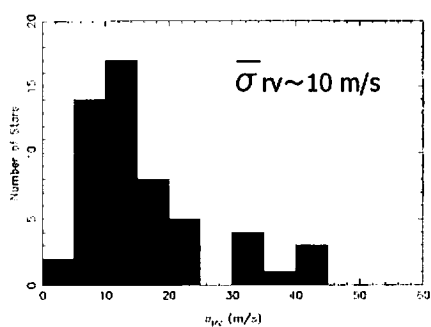
Observed radial velocity dispersion of HIDES 58 stars

(4 stars with dispersion several hundred m/s are not shown.)

- Most stars are stable in radial velocity at a level

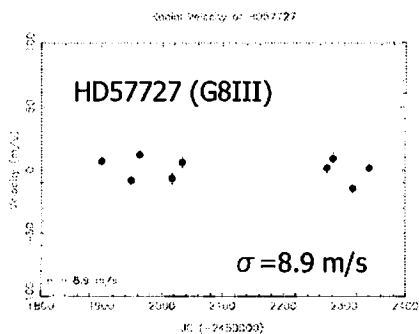
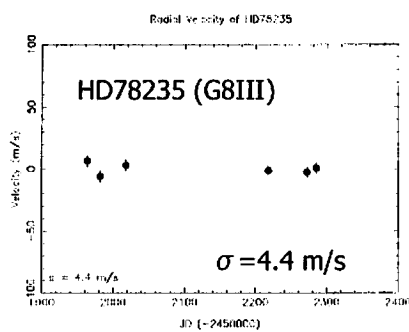
of < 20 m/s in a time span of 1 yr.

- About 15% of targets show velocity variations with $K > 50$ m/s and with periods several months.



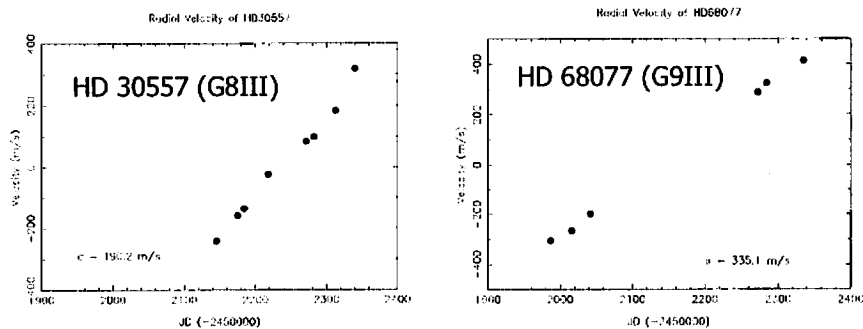
Preliminary Result (2)

Stars with small radial velocity dispersion



Preliminary Result (3)

Stars with large radial velocity variation



Summary

- Most of our targets show velocity dispersions of 5-20 m/s in a time span of 1 yr, which enable us to detect giant planets around them.
- We detected radial velocity variations in several stars with amplitudes several hundred m/s and time scales longer than 1 yr. If these are due to orbital motions, their companions are as heavy as at least several tens M_J .
- About 15% of the targets show velocity variations of 50-100 m/s with time scales of several months. If these are due to orbital motions, their companions are as heavy as several M_J .

Future Plans

- We started observations of remaining stars in HIDES sample from the second year and plan to continue this survey for 3 more years.
- We plan to do photometric observations of our targets showing radial velocity variations in order to examine their photometric variability and to search for planetary transits.
- Direct imaging of companions discovered by our survey is difficult even with Subaru+CIAO, but to search for more outer stellar and substellar companions is possible.