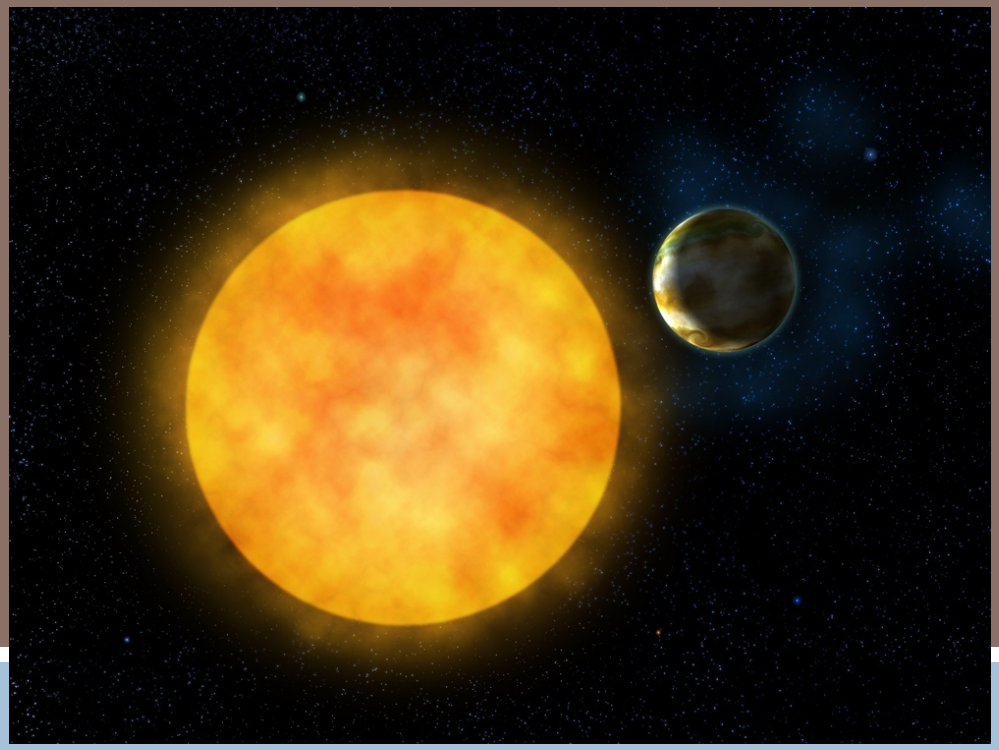
East-Asian Planet Search Network
–Searching for Exoplanets around Giants

Bun'ei Sato (Tokyo Institute of Technology)

Collaborators
M. Omiya, H. Harakawa, S. Ida,
M. Ikoma (Tokyo Tech.)
H. Izumiura, E. Kambe, Y. Takeda,
H. Ando, E. Kokubo (NAOJ)
Y. Yoshida (Hiroshima U.)
Y. Itoh (Kobe U.)

EAPSNET
Y. Liu, L. Wang, G. Zhao (China)
I. Han, B.C. Lee (Korea)
S. Selam, M. Yilmaz (Turkey)
I. Bikmaev (Russia)



(c) Okayama Astrophysical Observatory

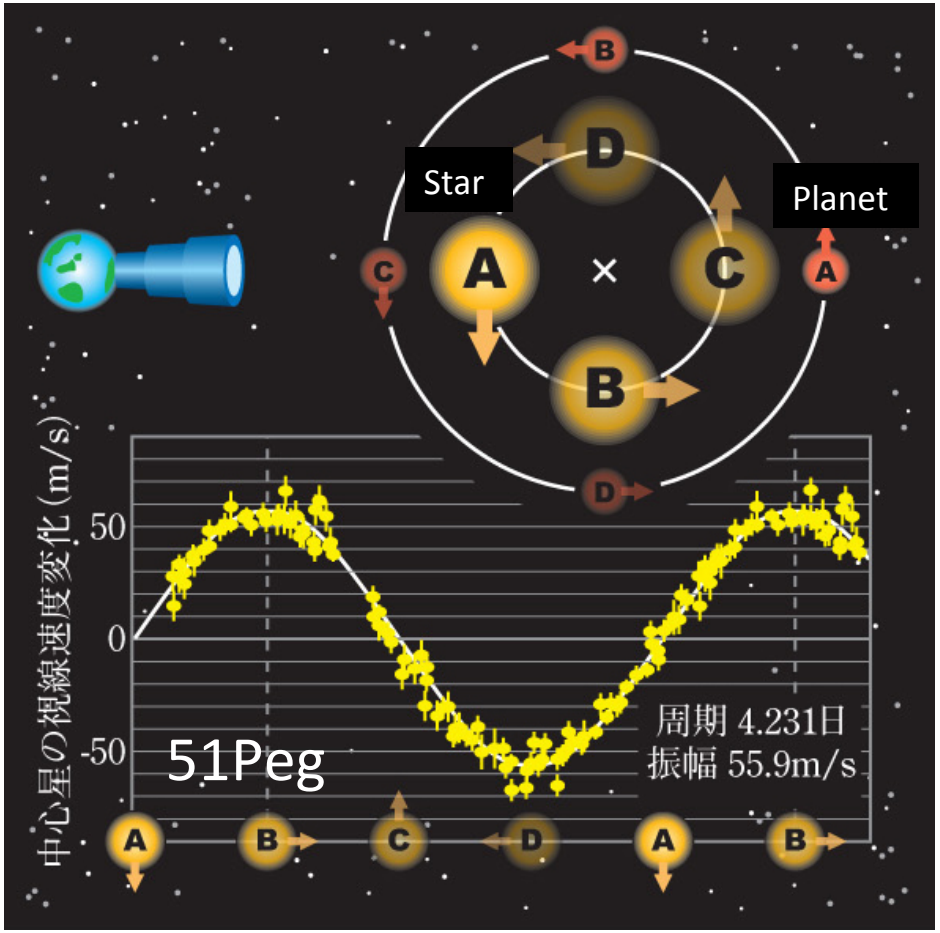
Contents

- Planet Detection
- Why evolved stars ?
- Latest results from EAPSNET
- Future

Planet Detection: RV method

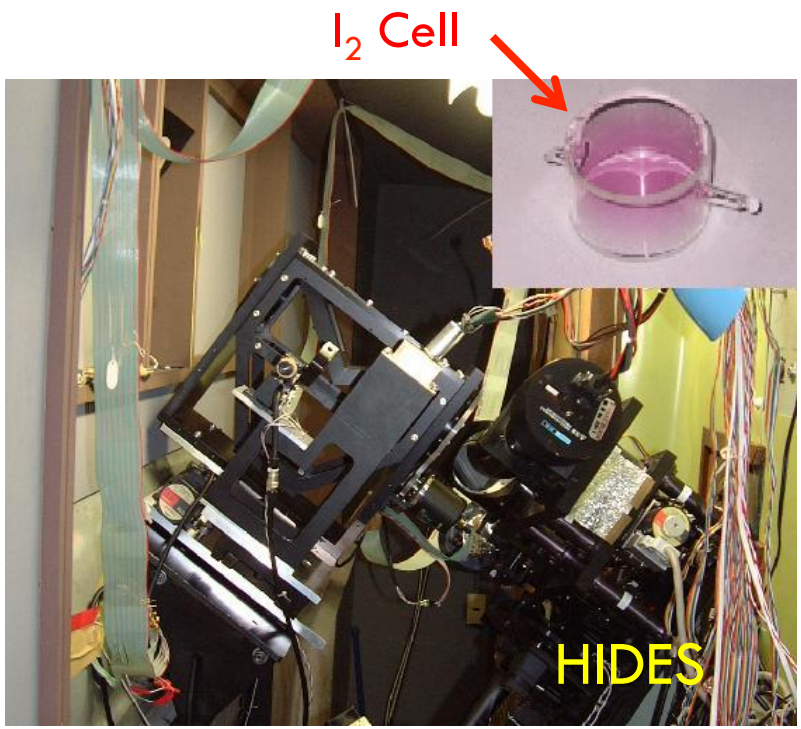
- Wobble in stellar radial velocity due to gravitational pull of planets
  - Sun-Jupiter => 13 m/s
  - Sun-Earth => 10 cm/s

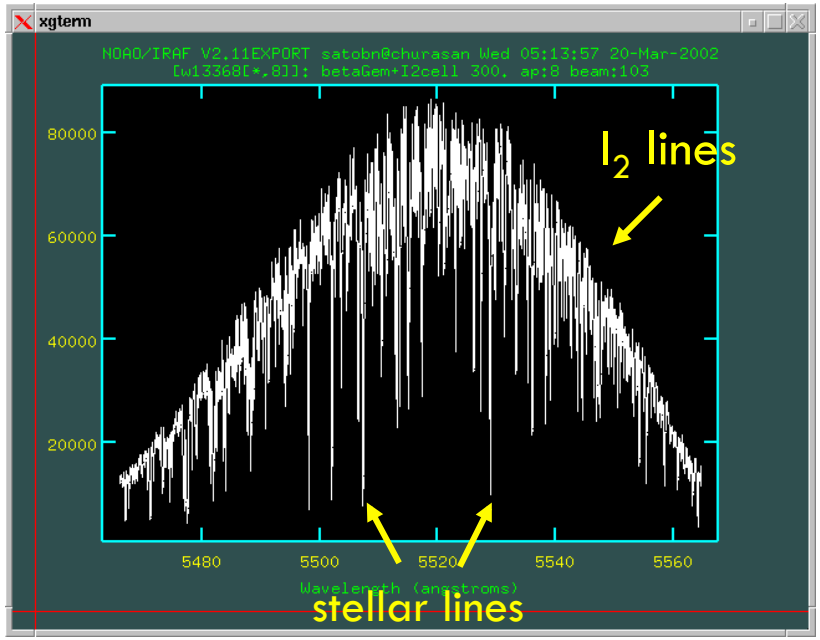
- Doppler shift in stellar light detected by spectroscopic observations



http://www.rikanenpyo.jp/kaisetsu/tenmon/tenmon_024.html

Iodine Absorption Cell

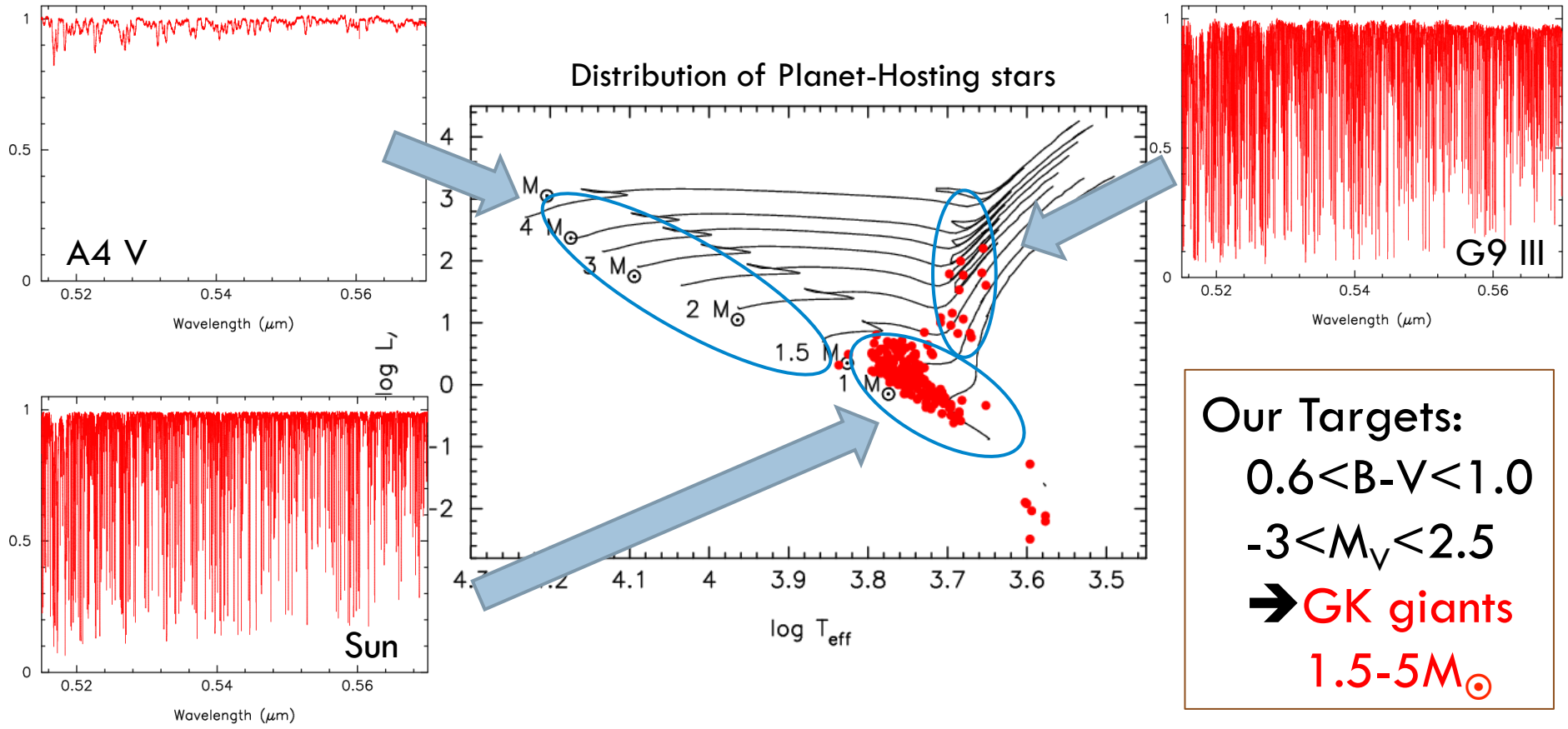




Superpose a reference iodine spectrum onto stellar spectrum

Measure shift of stellar lines relative to iodine lines

Why Evolved Stars ?



Our Targets:

0.6<B-V<1.0

$-3<M_V<2.5$

➔GK giants

$1.5\text{-}5M_\odot$

Planets around intermediate-mass stars are detectable by precise RV method at their evolved stages

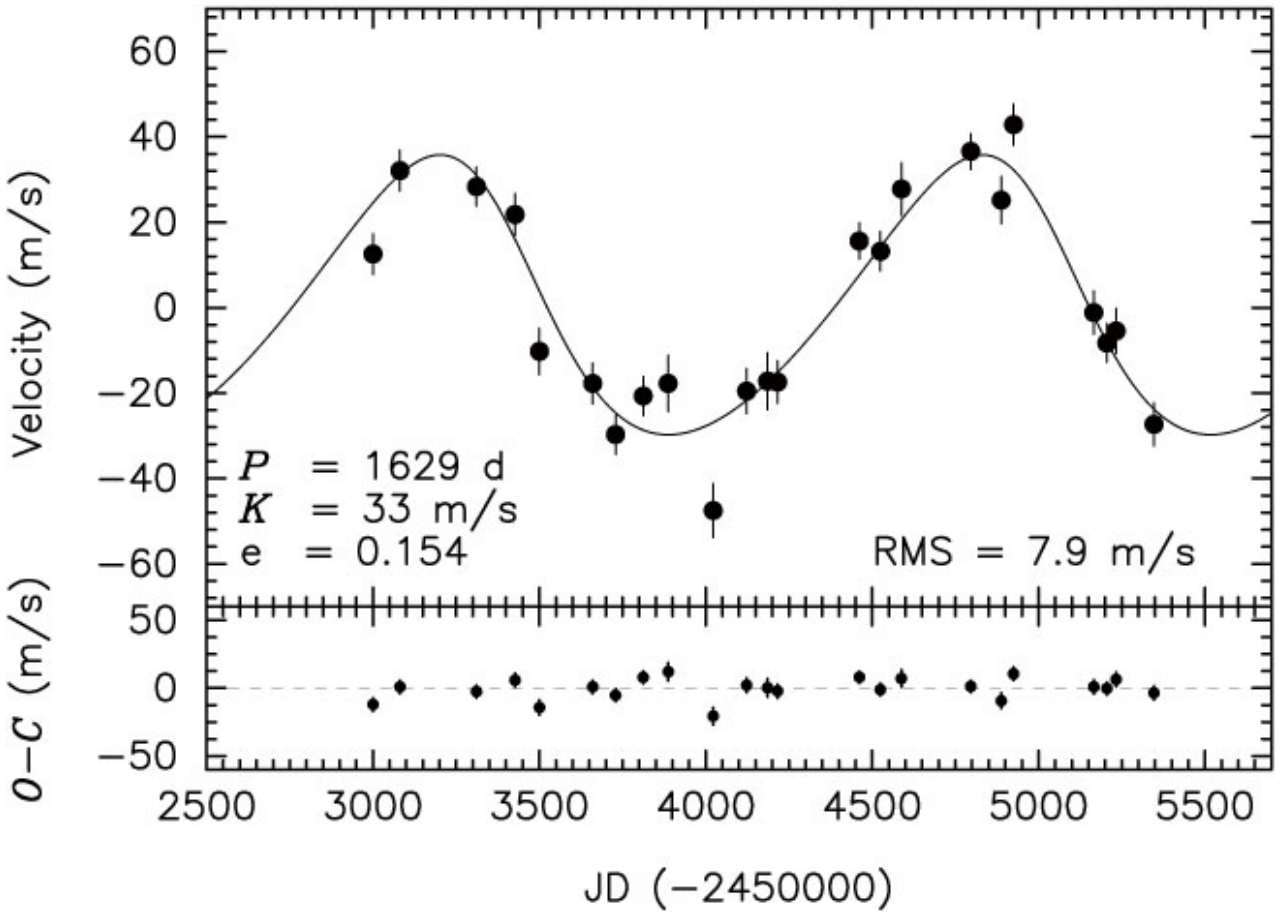
East-Asian Planet Search Network (EAPSNET)

- Japan: OAO 1.88m Tel., ~70 nights/yr
  - 300 GK giants (V<6), since 2001
  - 9 planets and 1 brown dwarf
- China-Japan: Xinglong 2.16m Tel., ~40 nights/yr
  - 100 GK giants (V~6), since 2005
  - 1 planet and 1 brown dwarf
  - Liu, Wang, Zhao et al.
- Korea-Japan: BOAO 1.8m Tel., ~2 weeks/yr
  - 190 GK giants (V<6.5), since 2005
  - 1 planet and 1 brown dwarf
  - Han, Lee et al.
- Japan: Subaru 8.2m Tel.
  - >200 GK giants (6.5<V<7), since 2006
  - 1 planet and 1 brown dwarf
- Turkey-Japan: TUBITAK 1.5m Tel.
  - 50 GK giants (V~6.5), since 2008
  - Selam, Bikmaev, Yilmaz et al.

~1/3 of the known planets around giants were found by us

Latest Results

Latest Result from OAO: A Long-period Planet



Sato et al. in prep.

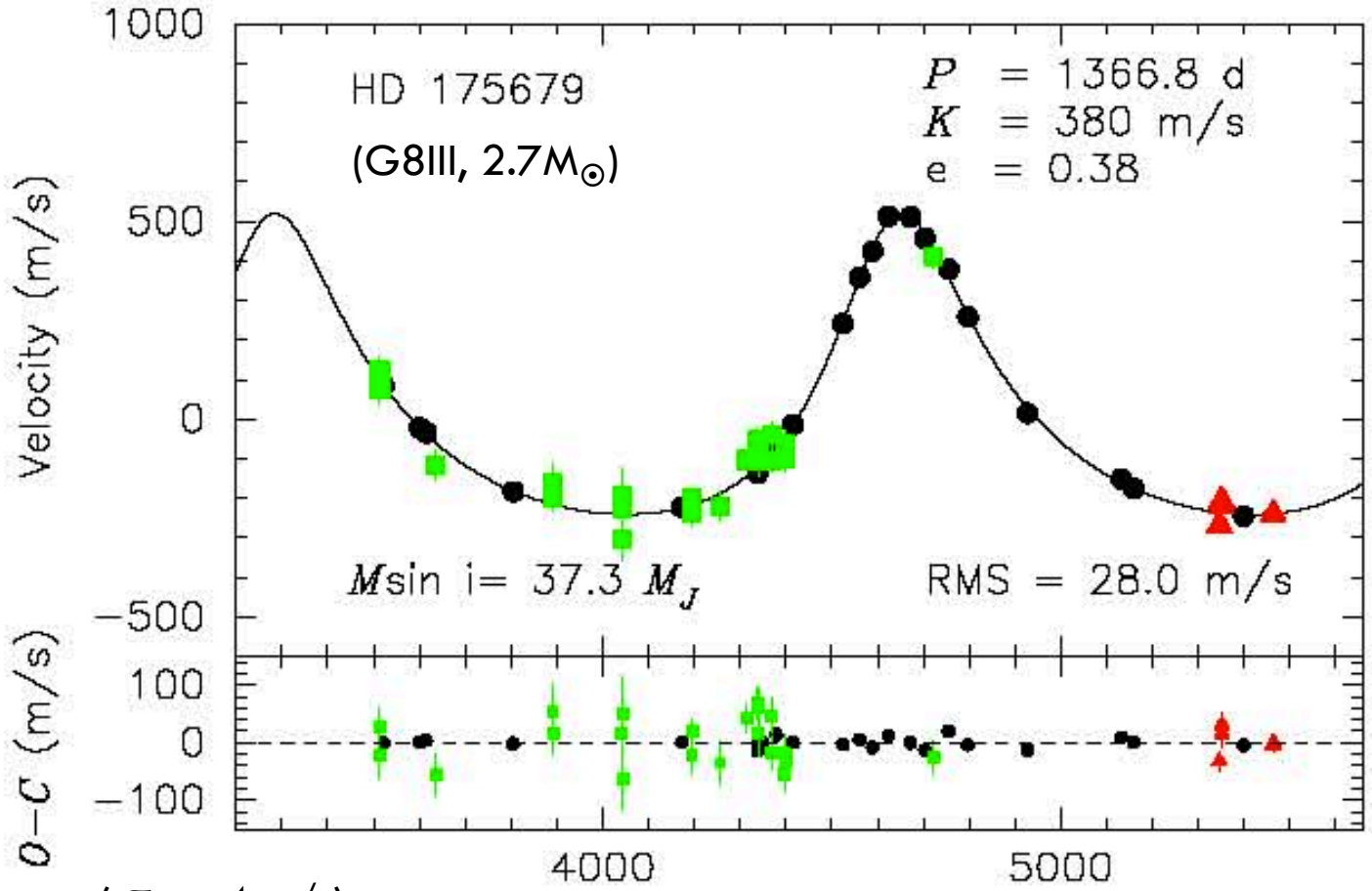
$M_p \sin i = 4 M_{JUP}$

$a = 4\,AU$

$M_\star = 3 M_\odot$

a>3 AU is considered to be the birth place of giant planets

Latest Result from Xinglong-OAO: A New Brown-Dwarf Companion



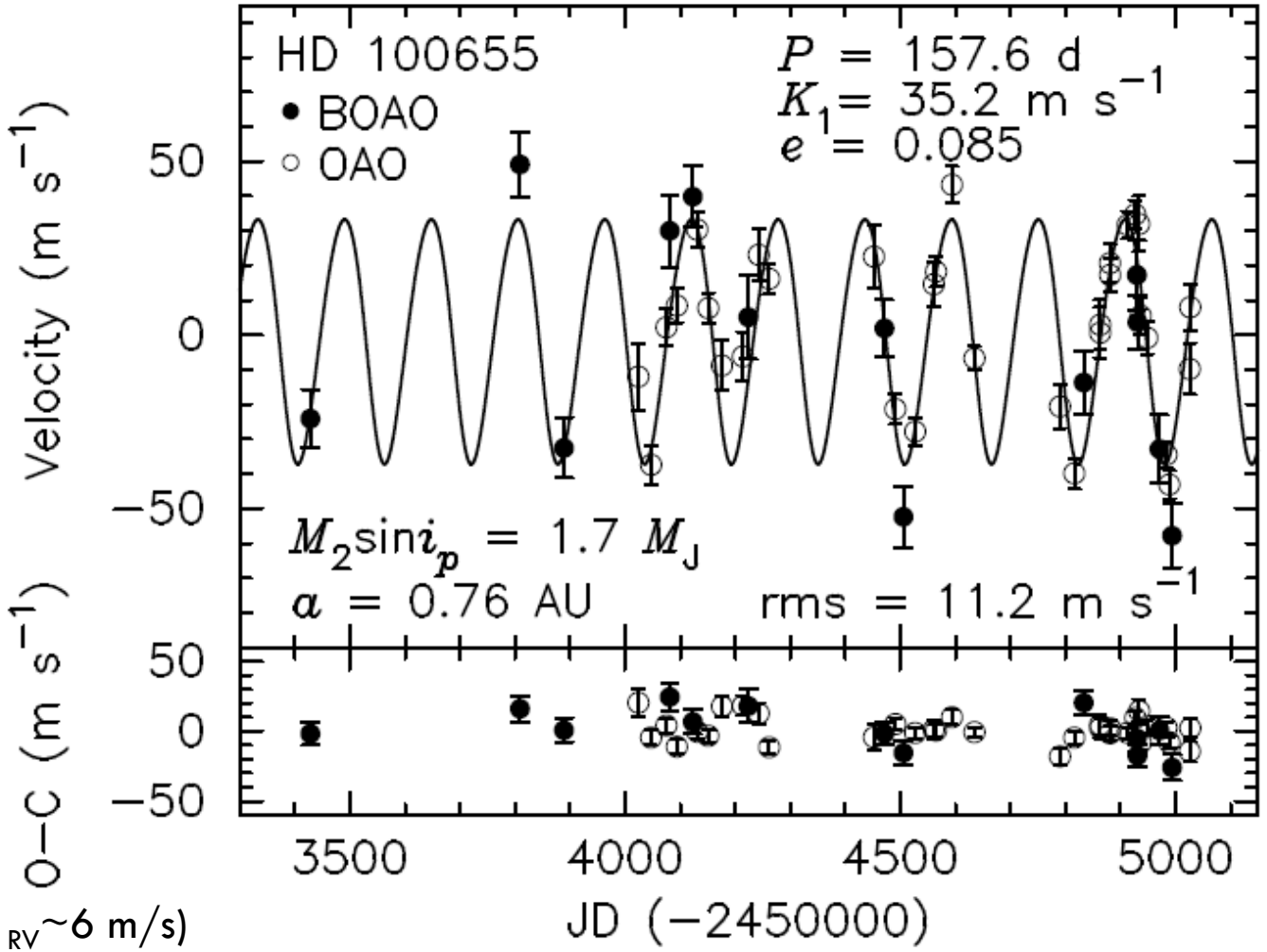
Black: Okayama (σ_{RV}~4 m/s)

Green: Xinglong old (σ_{RV}~30 m/s)

Red: Xinglong new (σ_{RV}~10 m/s)

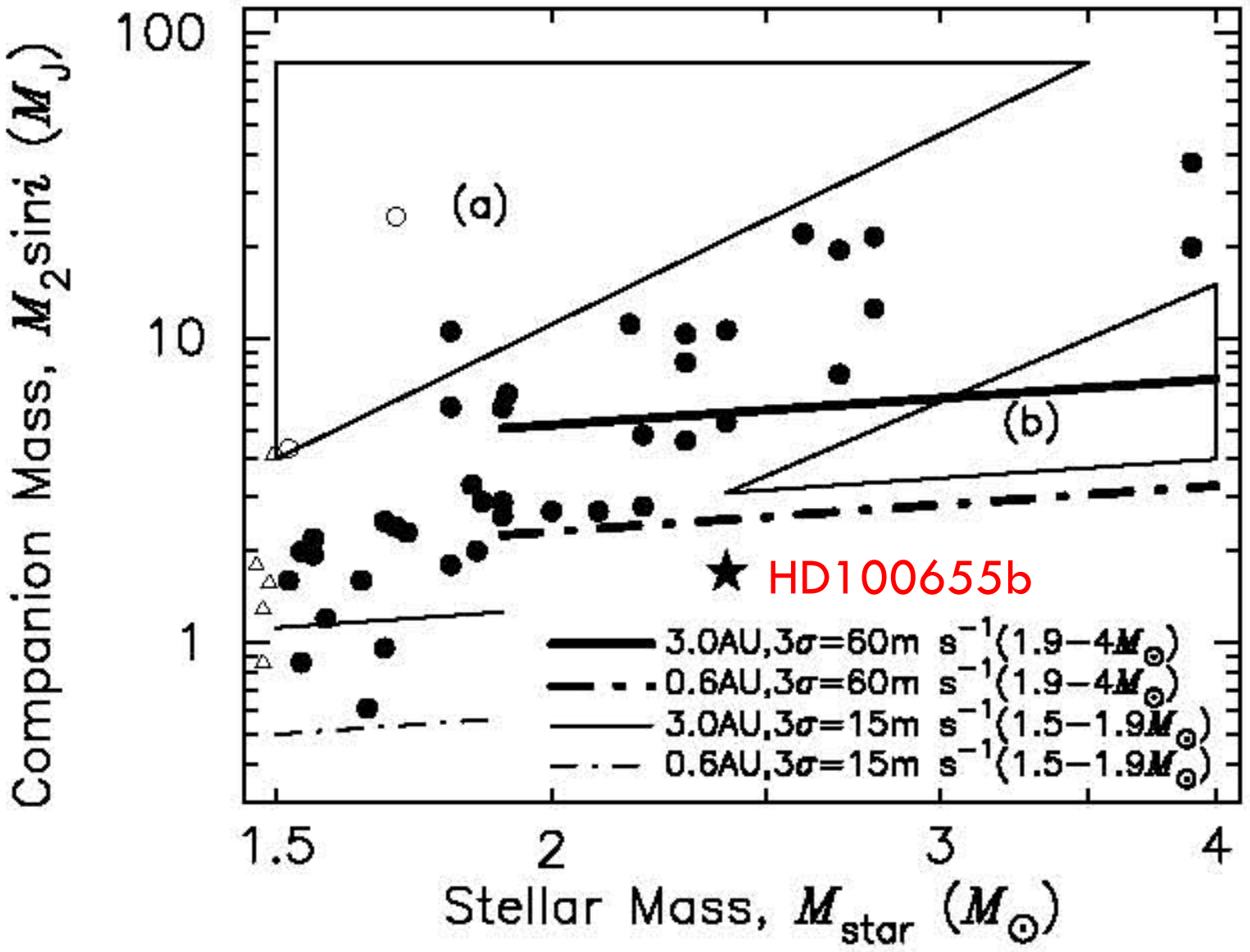
Wang et al. 2011, RAA, in press

Latest Result from BOAO-OAO: A New Planetary Companion



● OAO (σ_{RV}~6 m/s)
○ BOAO (σ_{RV}~10 m/s)

Omiya et al. 2011, PASJ, in press



Omiya et al. 2011, PASJ, in press

Towards Lower-mass Planets

- Stellar noise (oscillation)
  - ➔ detection limit
- Amplitude 10-20m/s,
  Period ~several hours
- Difficult to average out,
  but still possible

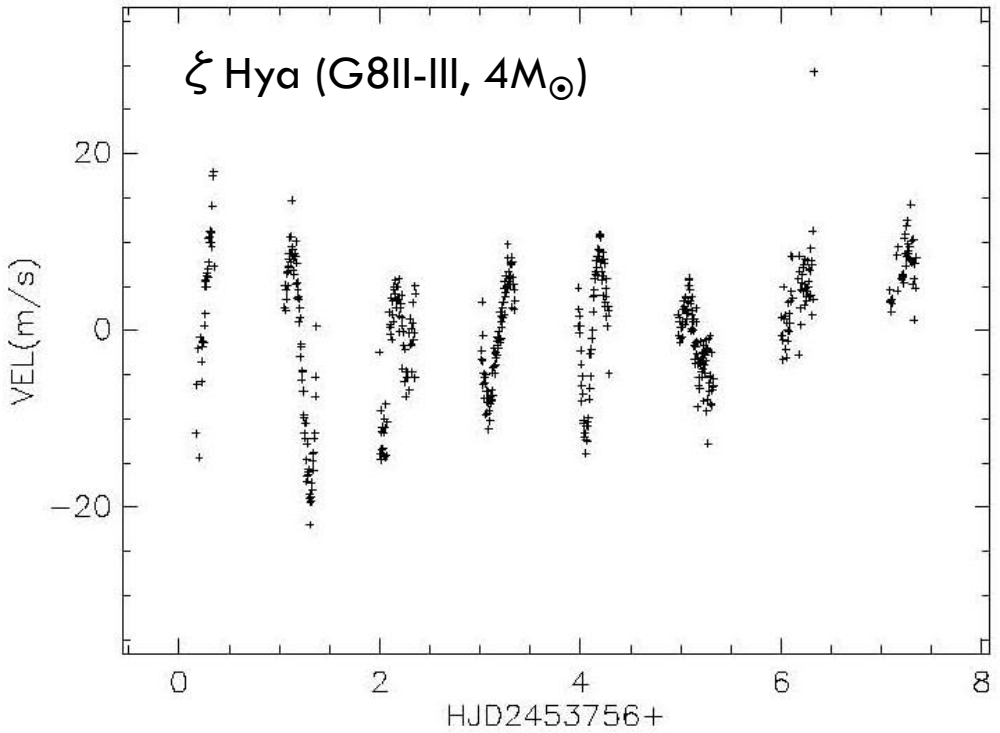
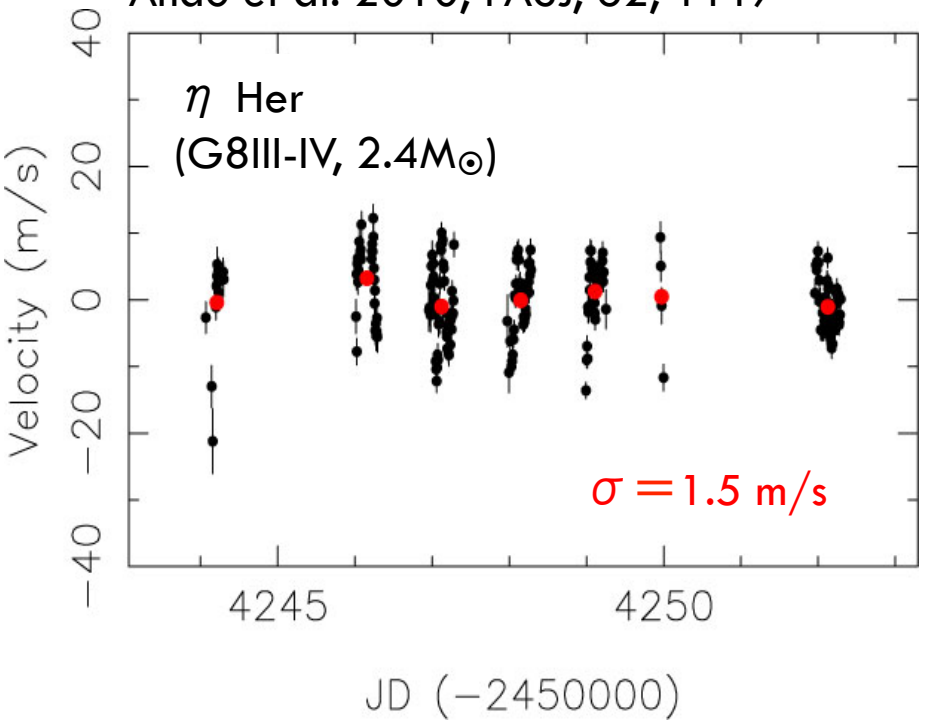


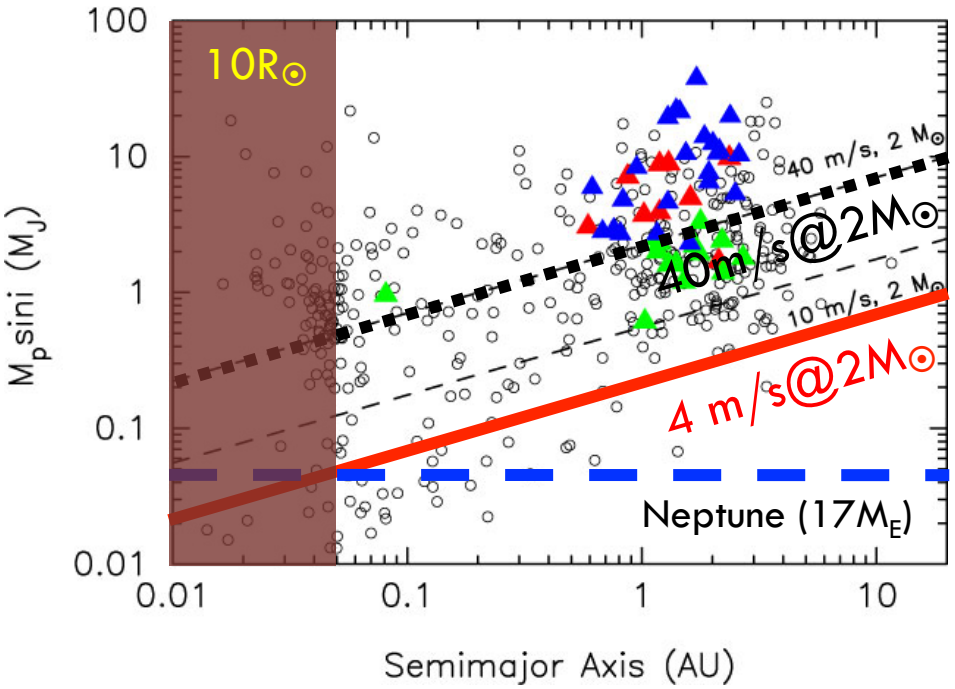
Fig.2 Radial velocity measurement of ζ Hya over 8 nights.

Ando et al. 2008, PASJ, 60, 219

High Cadence Observations for Detection of Low-mass Planets

Ando et al. 2010, PASJ, 62, 1117





Hot-Neptunes around Giants are detectable

It is difficult to detect such small planets around Giants by *Kepler*

Future

- More planets
  - Better statistics
  - Goal: 100 planets from ~1000 samples
- Longer-period Planets
  - Explore birth place of giant planets
  - Extend baseline to ~30 years
- Lower-mass Planets
  - High cadence observations
  - Down to Neptune-mass planets

Need more telescope time

Suitable science for 2-4m class telescopes