Planetary Companions to Three Intermediate-Mass GK Giants

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We have been carrying out a precise radial-velocity survey for planets around 300 intermediate-mass (1.5–5$M_\odot$) GK giants using the 188 cm telescope and the HIDES spectrograph at Okayama Astrophysical Observatory since 2001. The survey is one of the long-continued planet search programs in the world, and we have discovered 20 planets and 6 brown dwarfs so far, including those found by international collaborations. Here we report new planets around three GK giants: HD 2952 (K0III, 2.5$M_\odot$), HD 120084 (G7III, 2.4$M_\odot$), and ω Serpentis (G8III, 2.2$M_\odot$) [1]. Our group has now discovered about 40% of the planets and brown dwarfs currently known around intermediate-mass giants.

HD 120084 hosts an eccentric planet with minimum mass of 4.5M_{JUP} in an orbit with semimajor axis of 4.3 AU and an eccentricity of 0.66 (Figure 1). The planet has one of the largest eccentricities among those ever discovered around intermediate-mass giants. Although several scenarios proposed for the origins of such eccentric planets, including planet-planet scattering and secular perturbations by an outer body, expect existence of a distant companion, we can exclude the existence of a brown-dwarf companion within ~36 AU and a stellar one within ~90 AU around HD 120084 considering the lack of long-term radial-velocity trend in the star.

HD 2952 and ω Serpentis host a relatively low-mass planet with minimum masses of 1.6M_{JUP} and 1.7M_{JUP} in nearly circular orbits, respectively. The planets belong to a group of least-massive planets ever discovered around intermediate-mass giants. It is normally difficult to detect planets less massive than 2M_{JUP} around such giants because of the relatively larger stellar jitter (~10–20 m s^{-1}) compared to solar-type stars. However, our discoveries demonstrate that it is still possible to detect such less-massive planets, even around GK giants by high-cadence observations (Figure 2).

We also found out that the radial-velocity variations of stellar oscillations for G giants can be averaged out down to a level of a few m s^{-1}, at least on a timescale of a week by high-cadence observations. This enables us to detect a short-period super-Earth around giant stars.

We plan to continue the survey further, and expand it in anticipation of a coming era of space-based high-precision astrometry (GAIA) and high-precision photometry (TESS, CHEOPS).

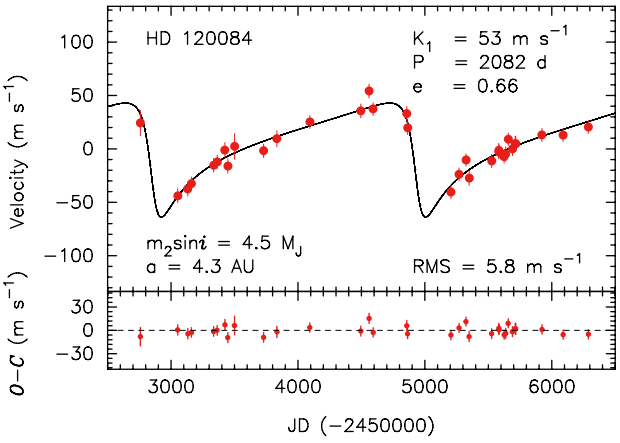

Figure 1: Radial-velocity variations of HD 120084. HIDES-Slit data are shown in filled red circles.

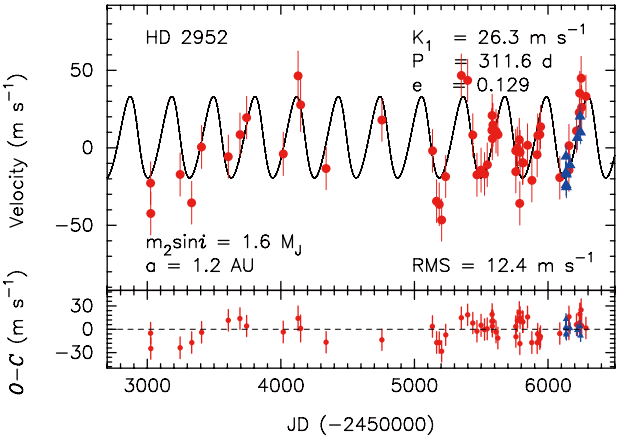

Figure 2: Radial-velocity variations of HD 2952. HIDES-Slit and HIDES-Fiber data are shown in filled red circles and filled blue triangles, respectively.

Reference

[1] Sato, B., et al.: 2013, *PASJ*, **65**, 85.