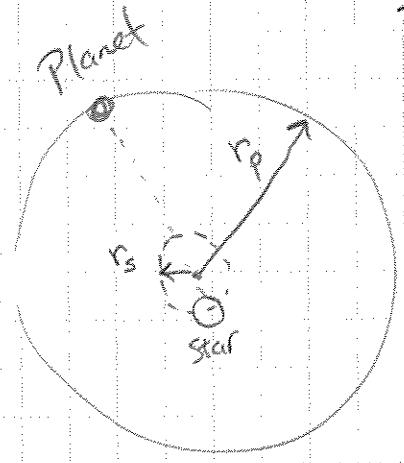
#2 File "rv2.dat" has radial velocities with a period of

$$P = 4.627669 \text{ days}$$

See Fig 6, and Winn et al., AJ 141, 63 (2011). If we assume the star has mass $1\,M_\odot$, and also assume

$$M_p \ll M_s = 1\,M_\odot$$

then we can find orbital radius like so.



- first, use maximum speed of star to compute radius of star's motion around center of mass

$$r_s = \frac{V_{max} \cdot P}{2\pi} = \frac{\left(210 \frac{m}{s}\right)(399{,}800\ s)}{2\pi}$$

$$= 1.336 \times 10^7\ m$$

- next, use Kepler's 3rd Law to find separation a

$$P^2 = a^3$$

P in years, a in AU

since we assume $M_s = M_\odot$

$$\rightarrow a = 8.13 \times 10^9\ m = 0.054\ AU$$

- now, $a = r_s + r_p \rightarrow r_p = a - r_s$

and center of mass tells us

$$\frac{M_p}{M_s} = \frac{r_s}{r_p} = \frac{r_s}{a - r_s}$$

p6

HW 4

#2

So

$$M_p = M_s \left(\frac{r_s}{a - r_s} \right)$$

$$= 1\, M_\odot \left(\frac{1.336 \times 10^7\ m}{8.13 \times 10^9\ m - 1.336 \times 10^7\ m} \right)$$

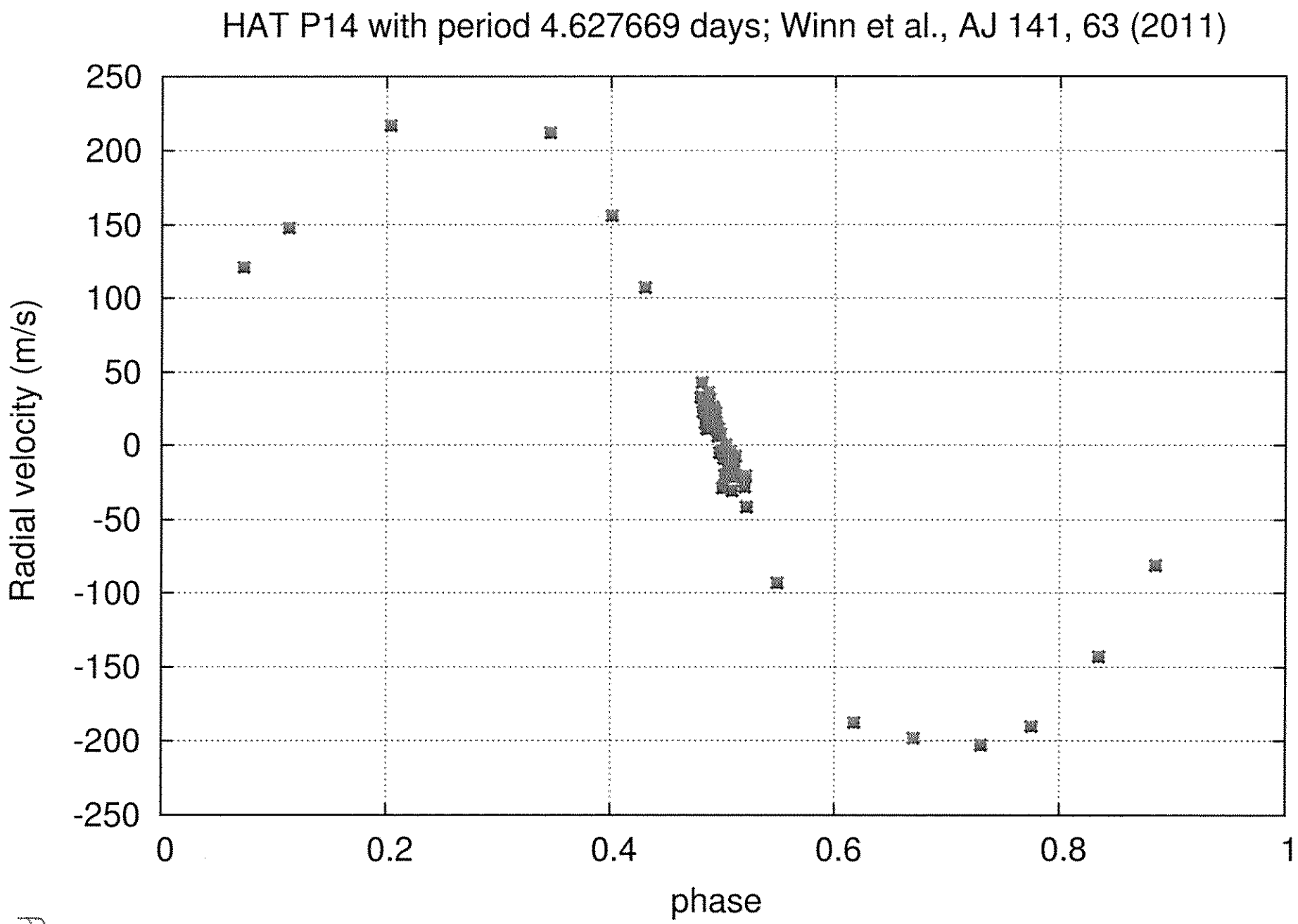
$$= 1.65 \times 10^{-3}\, M_\odot$$

$$\boxed{M_p = 1.7\ M_J}$$

and

$$\boxed{\begin{aligned} a &= 8.13 \times 10^9\ m \\ r_p &= 8.12 \times 10^9\ m \end{aligned}}$$

Bonus: HAT P-14b


HAT P14 with period 4.627669 days; Winn et al., AJ 141, 63 (2011)
Radial velocity (m/s)
phase
250
200
150
100
50
0
-50
-100
-150
-200
-250
0
0.2
0.4
0.6
0.8
1