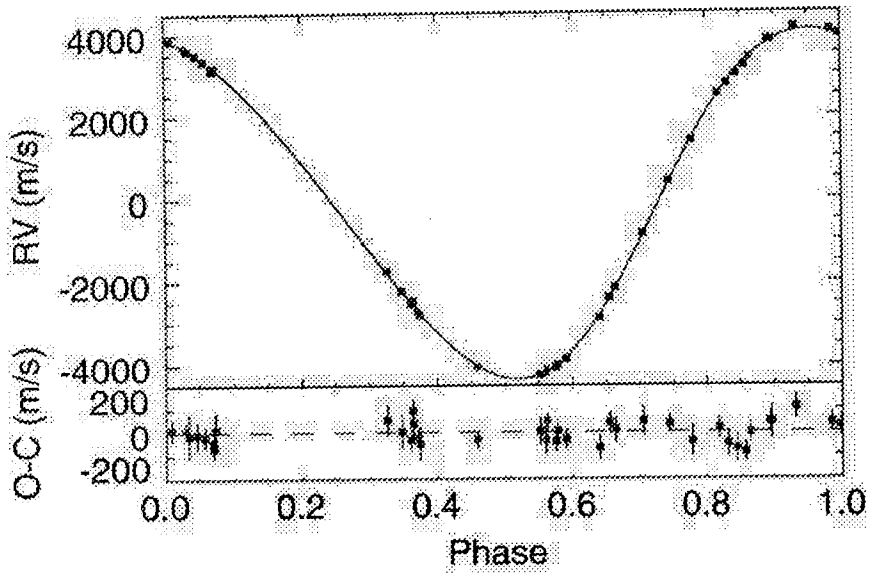
John

PROBLEM 5

The following radial velocity phase curve is observed for a companion orbiting a star. Assume e=0 and P=79 days:



a. (7 pts) Derive a general expression for the companion mass.

b. (1 pt) What is the minimum mass of the companion, assuming the host star is a Solar analog?

c. (1 pt) What is the semi-major axis, a, of the companion in AU? Assume sini = 1 and the host star is a Solar analog.

d. (1 pt) The companion is observed to transit the primary star, producing a 2% drop in flux. Assuming the primary is a Solar analog, what is the radius of the companion in R_{Sun}?

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Astro #5

* See pg 184 - 188 B.O.B

a) $e = 0 \rightarrow$ circular orbit

$P = 79$ days

$$P^2 = \frac{4\pi^2}{G(m_1+m_2)} a^3$$

* m_1 is mass of star, m_2 mass of companion

$$\left(\frac{GP^2}{4\pi^2 a^3}\right)^{-1} - m_1 = m_2$$

$$P = \frac{2\pi a}{v} \rightarrow \frac{Pv}{2\pi} = a$$

* but $v = \frac{v_r}{\sin i}$

$$\Rightarrow a = \frac{Pv_r}{2\pi \sin i}$$

$$\Rightarrow \frac{4\pi^2\left(\frac{P^3 v_r^3}{(2\pi)^3 \sin^3 i}\right)}{GP^2} - m_1 = m_2$$

$$\frac{v_r^3 P}{2\pi G \sin^3 i} - m_1 = m_2$$

b) * for minimum mass $\rightarrow \sin^3 i = 1$

$$\frac{v_r^3 P}{2\pi G} - m_1 = m_2$$

$$\frac{\left(4000 \frac{m}{s}\right)^3 \left(3.15 \cdot 10^7 \frac{s}{yr} \cdot 79\ yr\right)}{2\pi \left(6.67 \cdot 10^{-8}\right) \frac{cm^3}{g s^2}} - 2 \cdot 10^{33} g =$$