Practical

Notebook:	myao2018		
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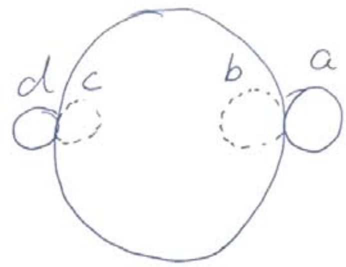
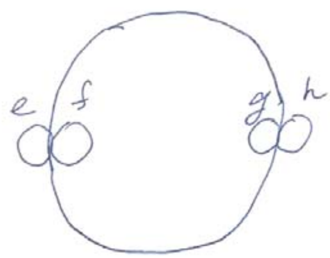
Location:	5°21'30 N 100°18'18 E		

Practical and Data Analysis

(1)





$r_s = r$

$r_e = R$

$$r_s = \frac{v}{2}(t_b - t_a) = \frac{v}{2}(0.09)$$

$$r_e = \frac{v}{2}(t_c - t_a) = \frac{v}{2}\cdot(0.10)$$

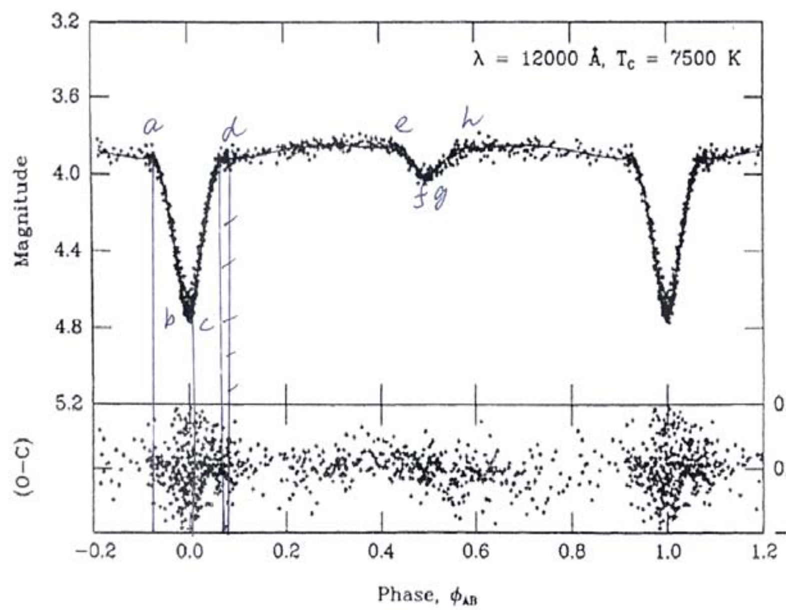
$$\therefore \frac{R}{r} = \frac{\frac{v}{2}(0.10)}{\frac{v}{2}(0.09)} = 1.11$$

(1) The light curve of an eclipsing binary star system is shown in the figure below. Estimate from this light curve the ratio R/r:

where:

R is the radius of the larger star
r is the radius of the smaller star

Assume that the eclipse is central, and the smaller star is a fainter star.



(2) Suppose tonight you are on a beach in Batu Ferringhi, Penang, and the sky is very clear and there is no moon and you can see many stars in the night sky. By using the star-chart that is provided and by observing the stars and constellations, describe one method how you can determine the four directions North, South, East and West while standing on the beach.

but if we choose a coordinate system for which the center of mass coincides with the origin of coordinates then the upper equation must be zero. In figure 6 we see a connection: $\mathbf{r}'_2 = \mathbf{r}'_1 + \mathbf{r}$ and from equation (7) it follows:

$$\mathbf{r}'_1 = -\frac{m_2}{m_1+m_2}\mathbf{r}$$
$$\mathbf{r}'_2 = \frac{m_1}{m_1+m_2}\mathbf{r} \tag{9}$$

If we consider only the lengths of the vector $\mathbf{r}'_1$ and $\mathbf{r}'_2$ we find out:

$$\frac{m_1}{m_2} = \frac{r'_2}{r'_1} = \frac{a_2}{a_1} \tag{10}$$

where a_1 and a_2 are the semi-major axes of the ellipses. If we assume that the orbital eccentricity is very small, then the velocity of stars are $v_1 = 2\pi a_1/t_0$ and $v_2 = 2\pi a_2/t_0$. From chapter 3.4 we know that the velocity depends on inclination and radial velocity for both stars are $v_{1r} = v_1 \sin i$ and $v_{2r} = v_2 \sin i$. If we carry this in equation (10) we get:

$$\frac{m_1}{m_2} = \frac{v_{2r}}{v_{1r}} \tag{11}$$

3.6 Inclination, radii and temperature

Inclination i is the angle between the orbital plane and plane-of-sky [1]. It can assume any value on the interval $[0, 90°]$, where $i = 0°$ means that we look on the plane of the system face on and if $i = 90°$, then we see a binary from the edge.

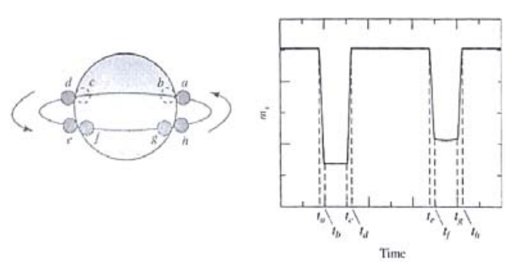


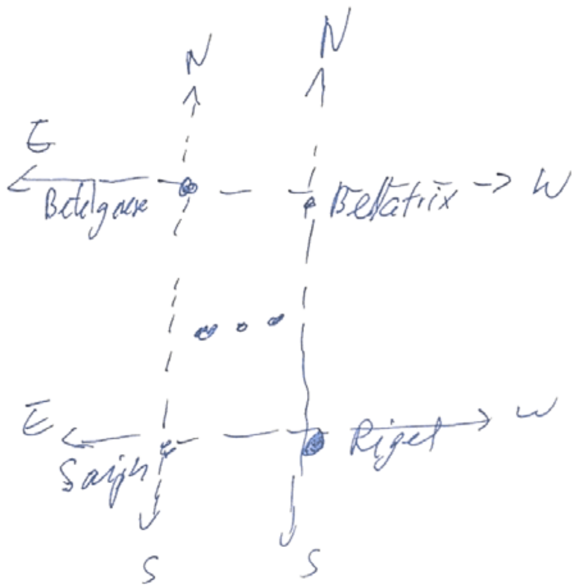
Figure 7: The light curve of eclipsing binary for which is $i = 90°$. From the times indicated on the light curve we can get radii for both stars [4].

From a phase light curve, more exactly from duration of eclipses, we can get the radii of each member. Referring to the figure 7, the amount of time between first contact (t_a) and minimum light (t_b), combined with the velocities of the stars, lead directly to equation of the radius of smaller star and similarly for a bigger star for second eclipse [4]:

$$r_s = \frac{v}{2}(t_b - t_a)$$
$$r_l = \frac{v}{2}(t_c - t_a) = r_s + \frac{v}{2}(t_c - t_b) \tag{12}$$

$v = v_s + v_e$ is the relative velocity of the two stars.

2) Many stars and constellations can be used.
For example, the constellation of ORION
the Hunter

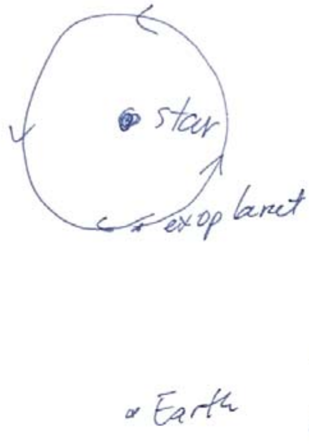


(100)

~~50~~

(3) Two main methods to detect exoplanets

(I) Radial Velocity Method

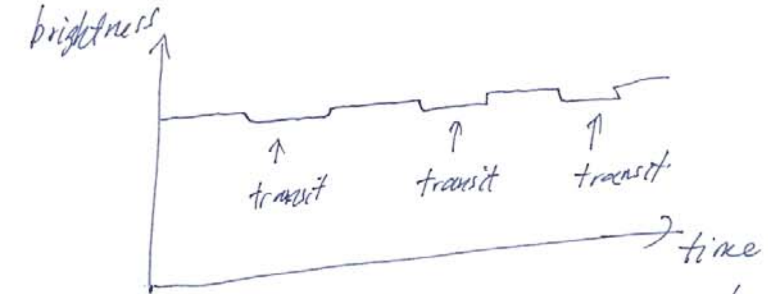


By observing the fine stellar spectral absorption lines ~~of the~~ from the Earth, we can see that these absorption lines are regularly redshifted and blueshifted and so on. This show that the star is being "pulled" towards and away from the Earth by the exoplanet. We can ~~kno~~ then know the period of the orbit of the exoplanet around ~~from~~ the star and the mass of the star

OR

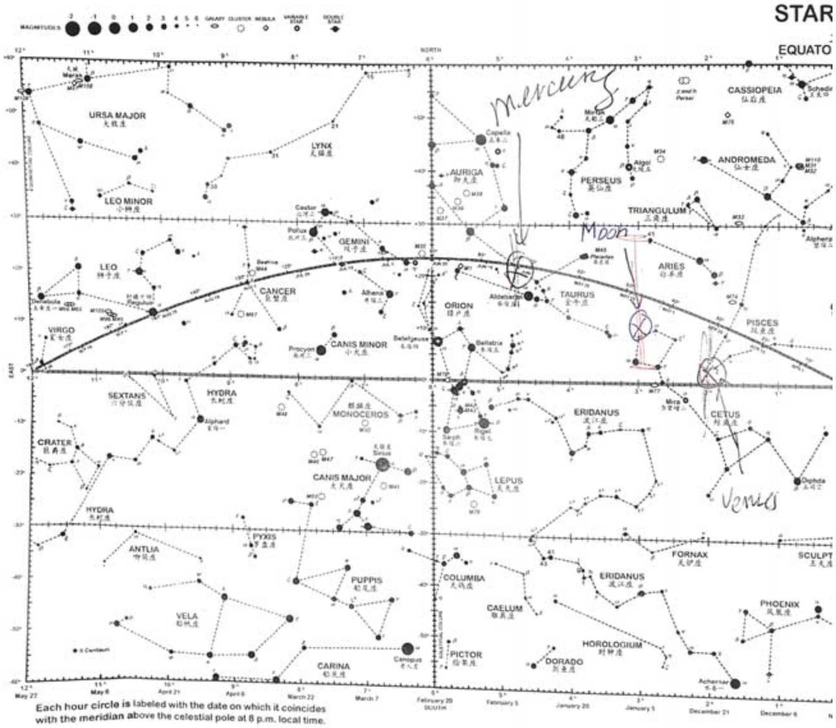
(II) Transit Method

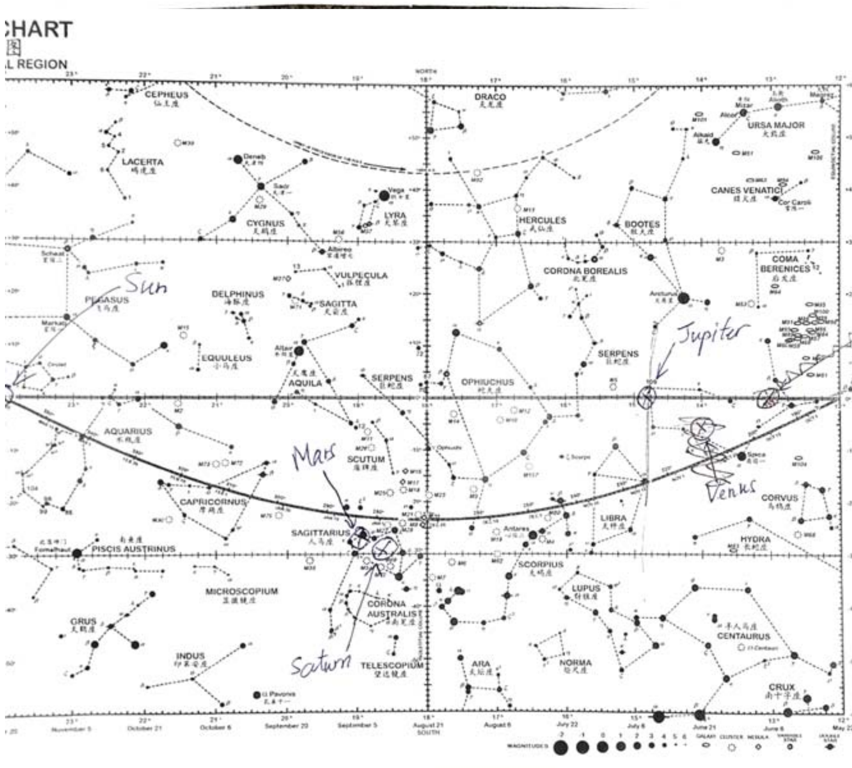
By measuring the light-curve of the star, and if there is an exoplanet transiting the dish of the star regularly, we can get the result below.



The 'dips' in the light curve show that the exoplanet is transiting the star. From this light-curve, we can obtain the period of the orbit of the exoplanet around the star and the mass of the star.

Question 4





$\frac{11}{15} \times 12$

$\frac{4}{15} \times 12$

$\frac{48}{15} = 3.$

(4) Refer to star chart

(For example)

(5) (i) This star's spectrum is rich in elements heavier than ~~the~~ helium, such as K, O, Mg, Na, N and S.

(ii) Because the ~~at~~ stellar atmosphere has heavy elements, this is a Population I (Type I) star. Population I stars are found in the galactic disk and spirals of a galaxy and are younger stars as compared to Population II stars which are older stars

(iii) From the continuum part of the spectrum and also the intensity of the absorption we can estimate the temperature of the star's atmosphere

(iv) Because of the H_α, H_β and H_γ lines and other excited atoms ~~the~~ it is an A-Type star (~ 9,500K for its atmosphere)

(v) From the Doppler shifts in the absorption lines we can estimate the radial velocity of the star (+ or −)