Assignment #1

Abhinna Sundar
Krittika Summer Projects, IITB
IISER Mohali

May 11, 2020

Question 1: Mass of star in binary star system

Let the masses of stars be m_A and m_B and their respective distance from COM be r_A and r_B. The distance between both the stars is r. The centre of mass relation, $m_A r_A = m_B r_B$ which gives,

$$r_A = \frac{m_B r}{m_A + m_B}$$
$$r_A = \frac{m_B r}{M}$$

where M is ttoal mass of the system.
The forces acting on each star are balanced, so gravitational force equals the centripetal force i.e. $F_G = F_C$

$$\frac{G m_A m_B}{r^2} = \frac{m_A v_A^2}{r_A}$$

v_A is the orbital speed of m_A.
We can measure v_A from T the time period, $v_A = 2\pi r_A/T$ and substituting in above, we get,

$$m_B = \frac{2\pi v_A r^2}{GT}$$

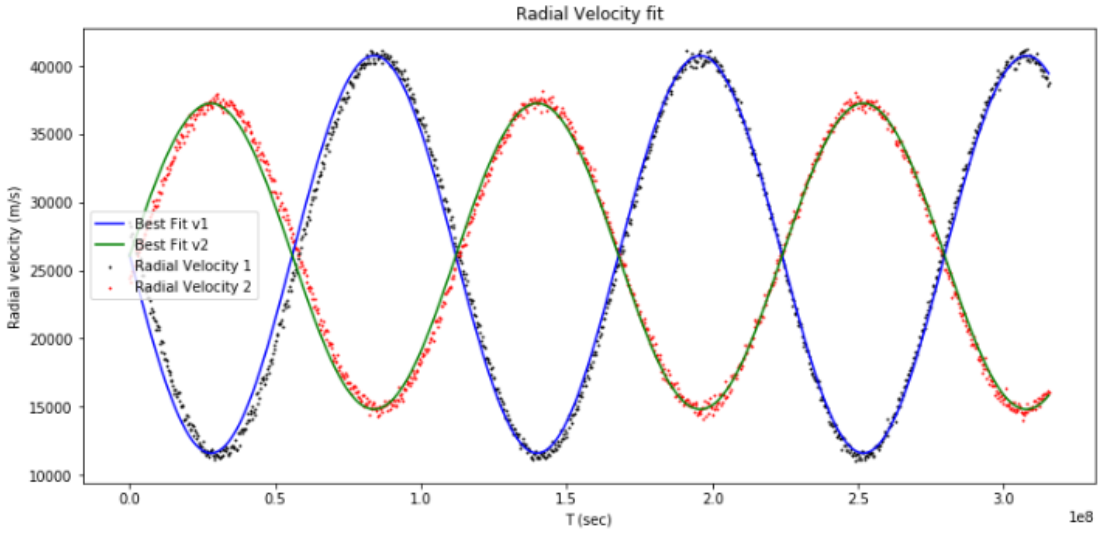
which is the mass of B star.
Similarly, we can find the mass of star A as:

$$m_A = \frac{2\pi v_B r^2}{GT}$$

where $r = r_A + r_B = \frac{T(v_A+v_B)}{2\pi}$
Thus, substituting it, we get:

$$m_A = \frac{T v_B (v_A + v_B)^2}{2\pi G}$$
$$m_B = \frac{T v_A (v_A + v_B)^2}{2\pi G}$$

Out[140]: <matplotlib.legend.Legend at 0x22c8b9c28c8>



Out[142]: <matplotlib.legend.Legend at 0x22c8ba4e508>