

54. The magnitude of the net gravitational force on one of the smaller stars (of mass m) is

$$\frac{GMm}{r^2} + \frac{Gmm}{(2r)^2} = \frac{Gm}{r^2} \left(M + \frac{m}{4} \right) .$$

This supplies the centripetal force needed for the motion of the star:

$$\frac{Gm}{r^2} \left(M + \frac{m}{4} \right) = m \frac{v^2}{r} \quad \text{where } v = \frac{2\pi r}{T} .$$

Plugging in for speed v , we arrive at an equation for period T :

$$T = \frac{2\pi r^{3/2}}{\sqrt{G(M + m/4)}} .$$