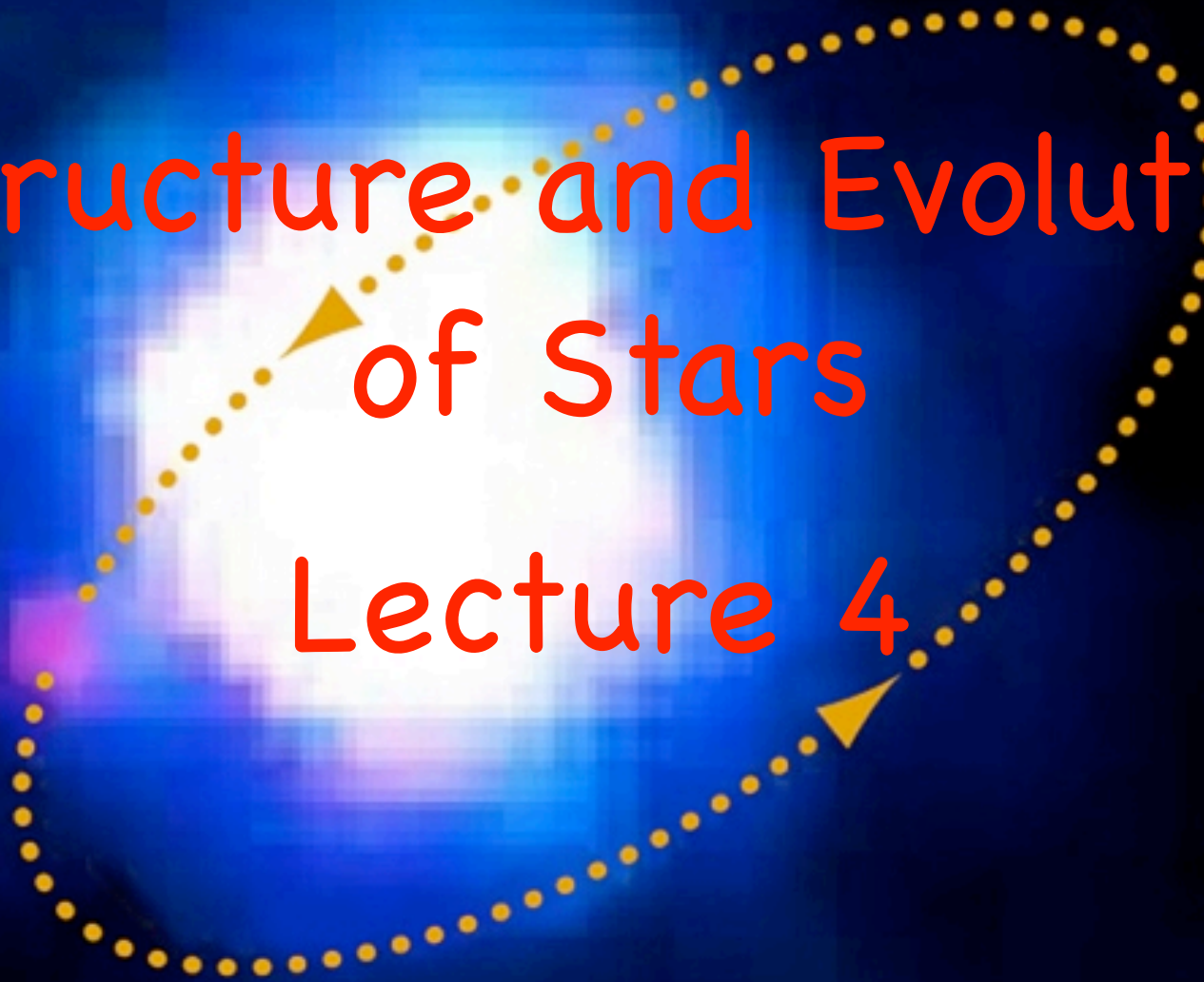


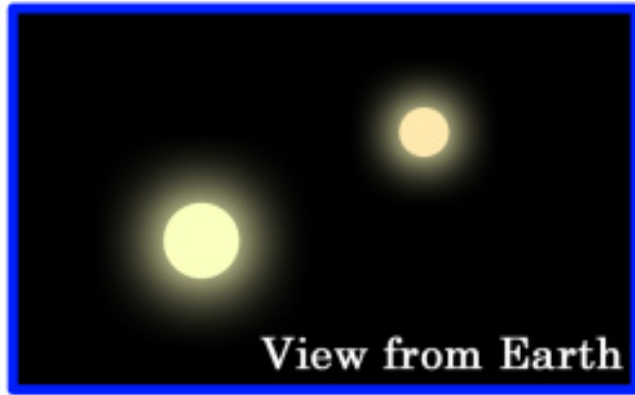
Orbit of AB Dor C

# Structure and Evolution of Stars

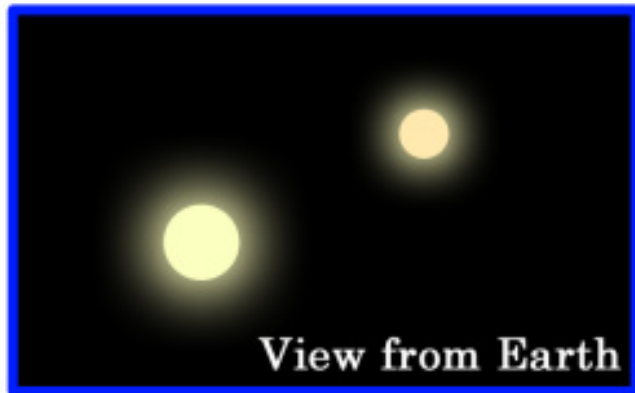
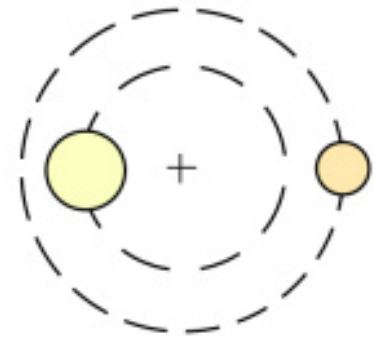
## Lecture 4





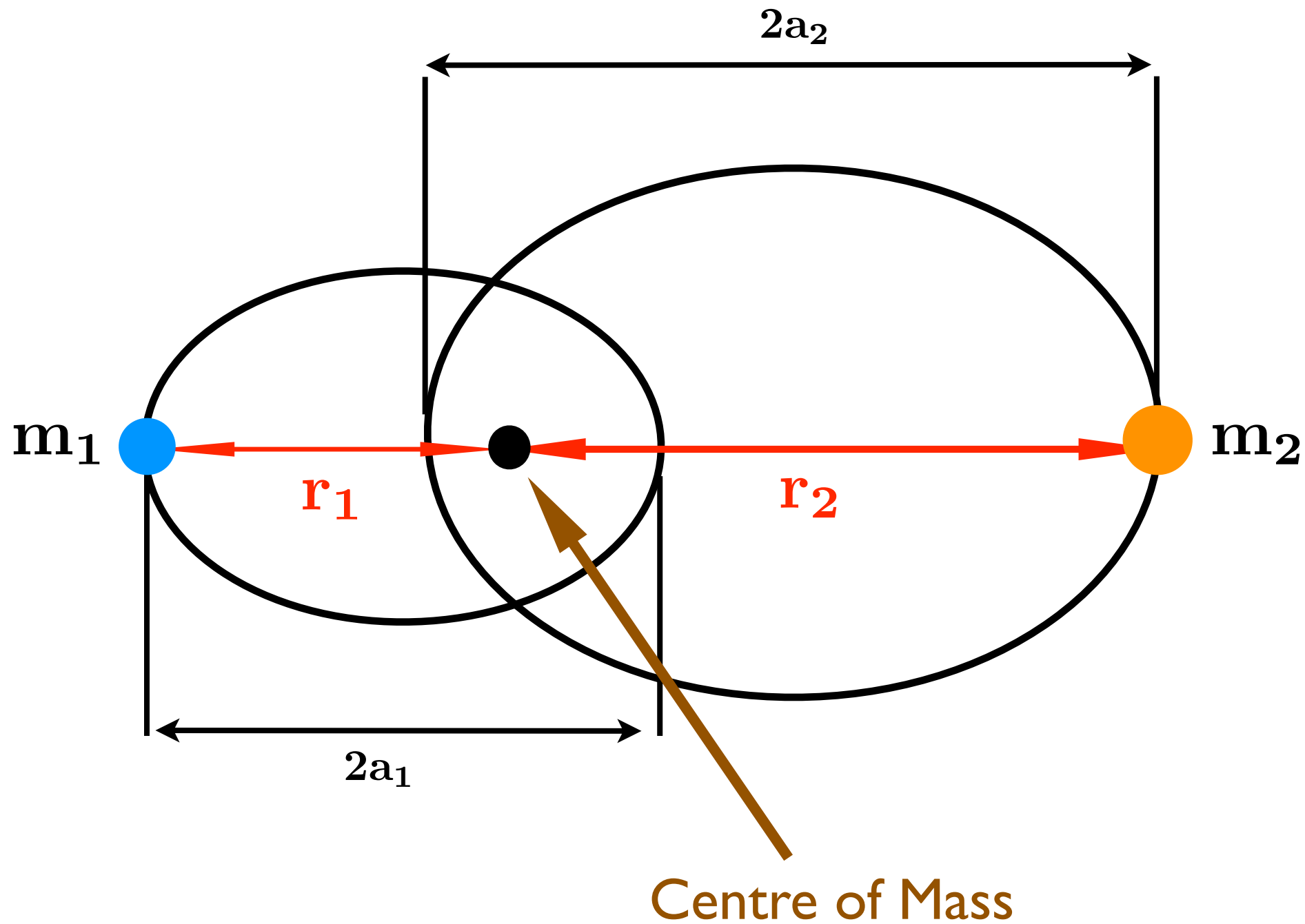


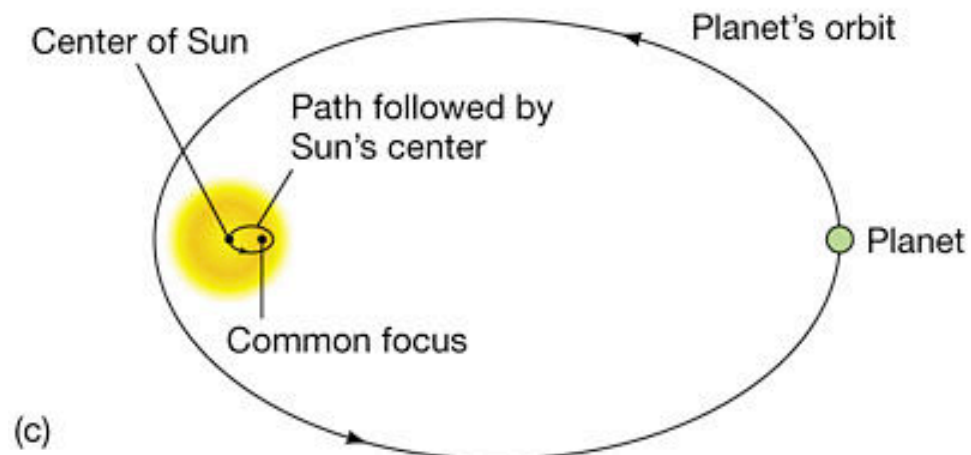
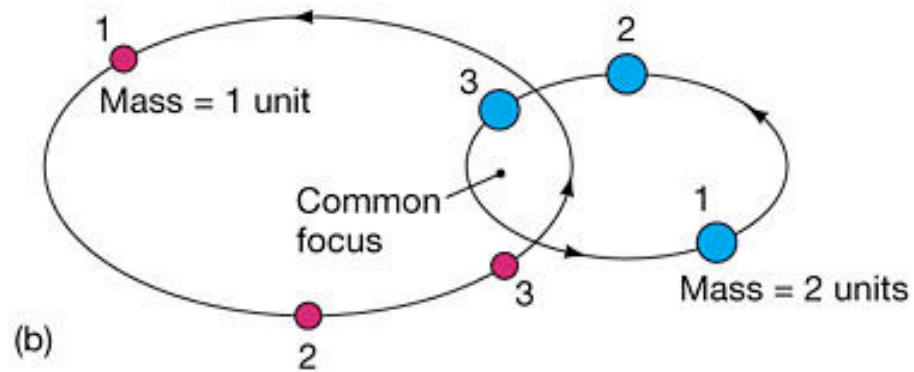
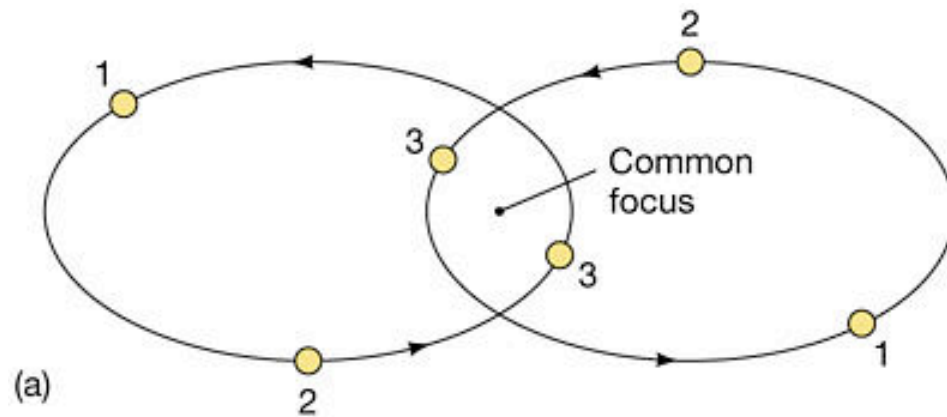
Visual Binary Stars

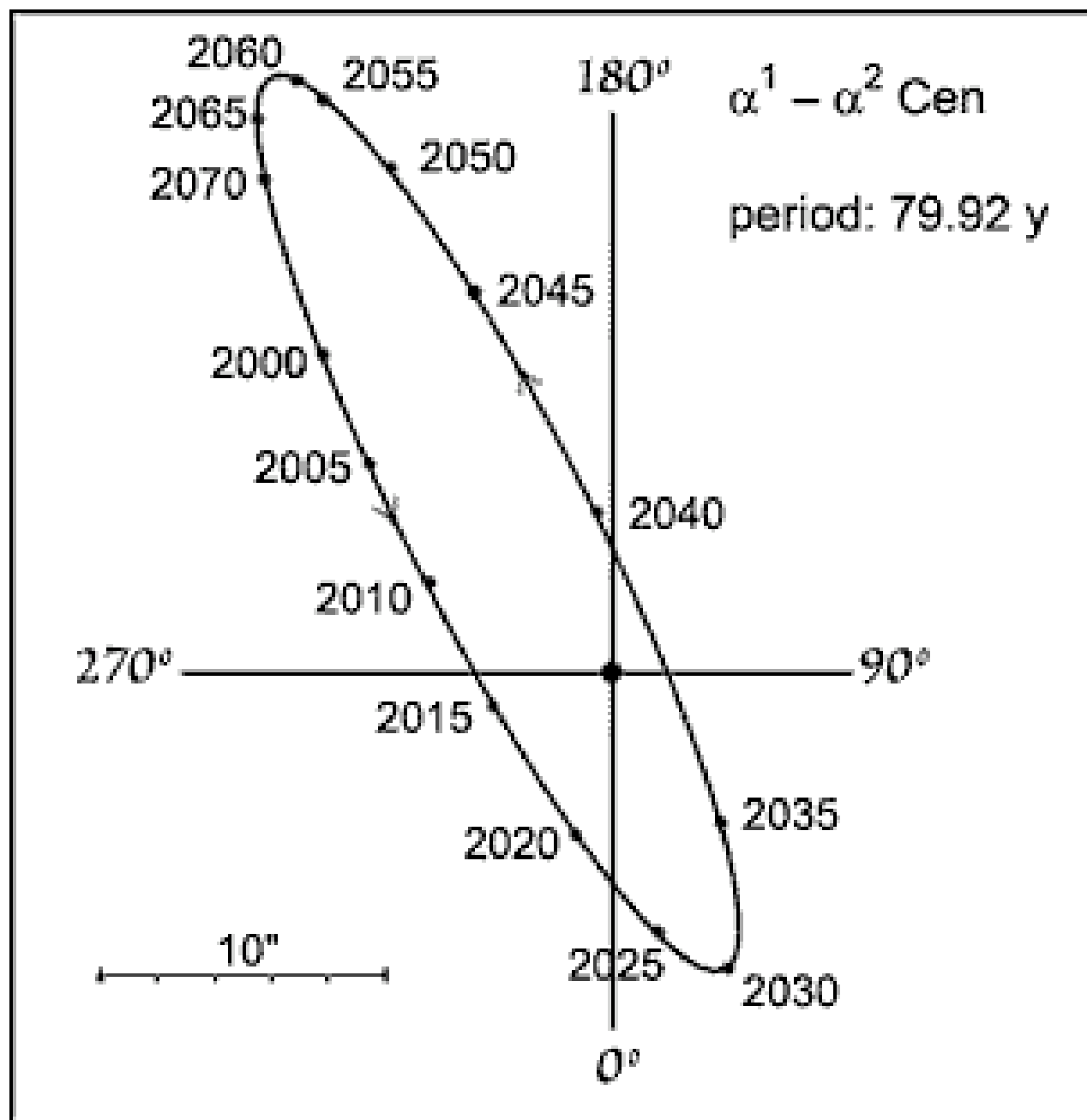


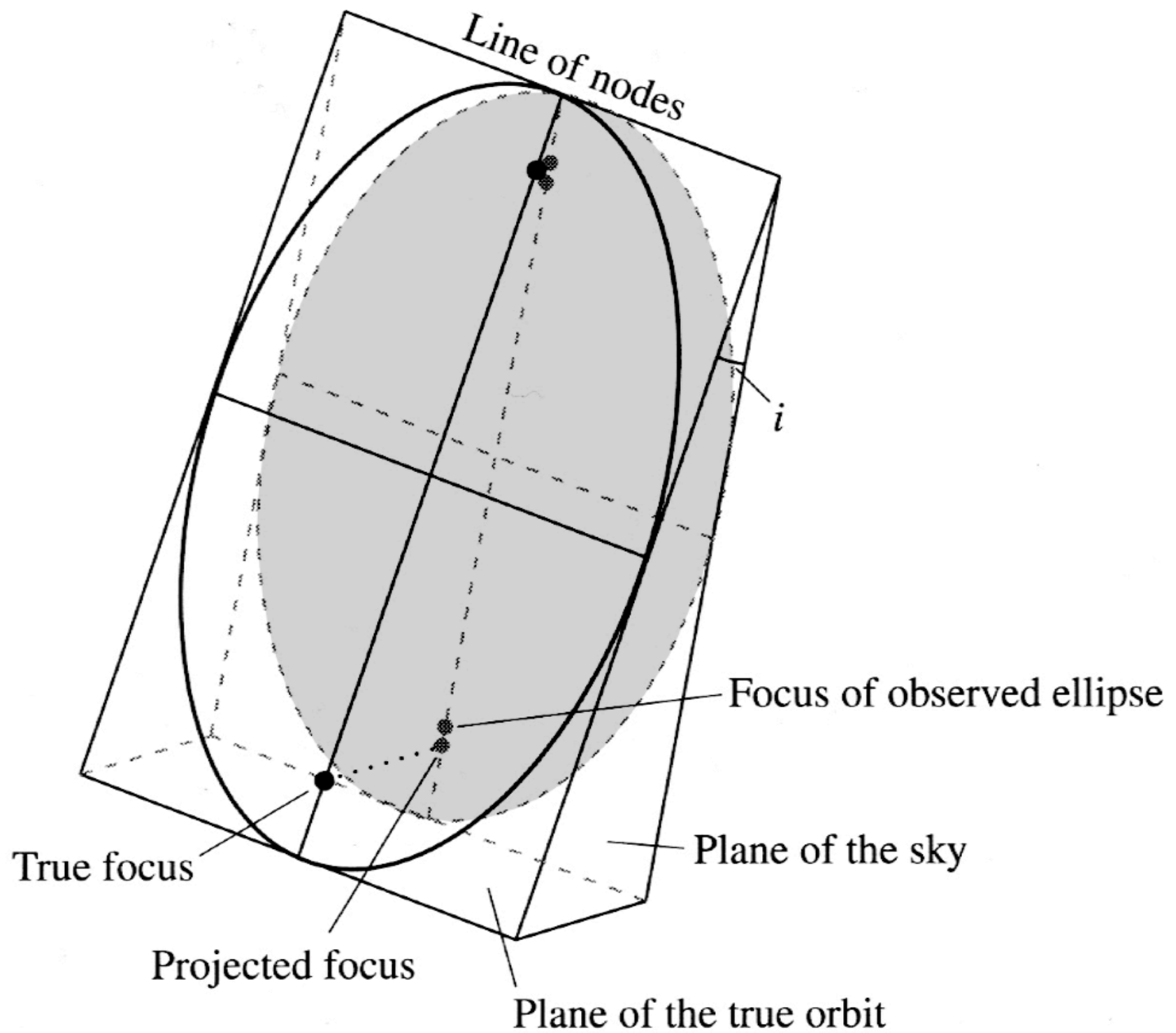
Optical Double Stars



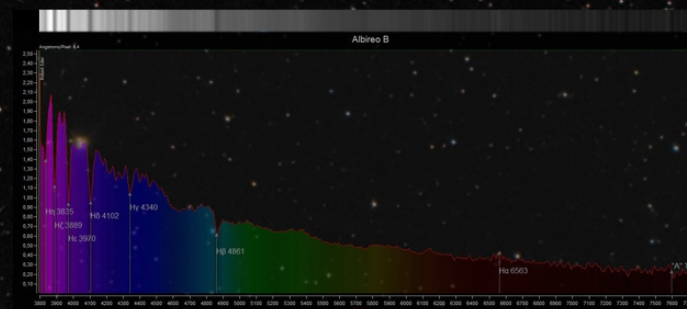




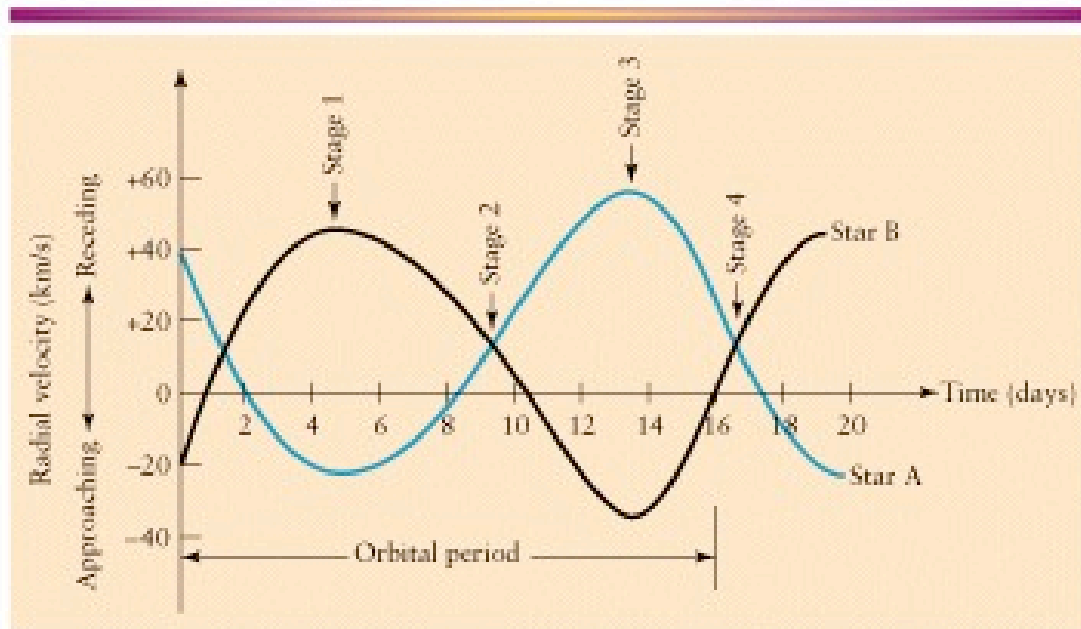
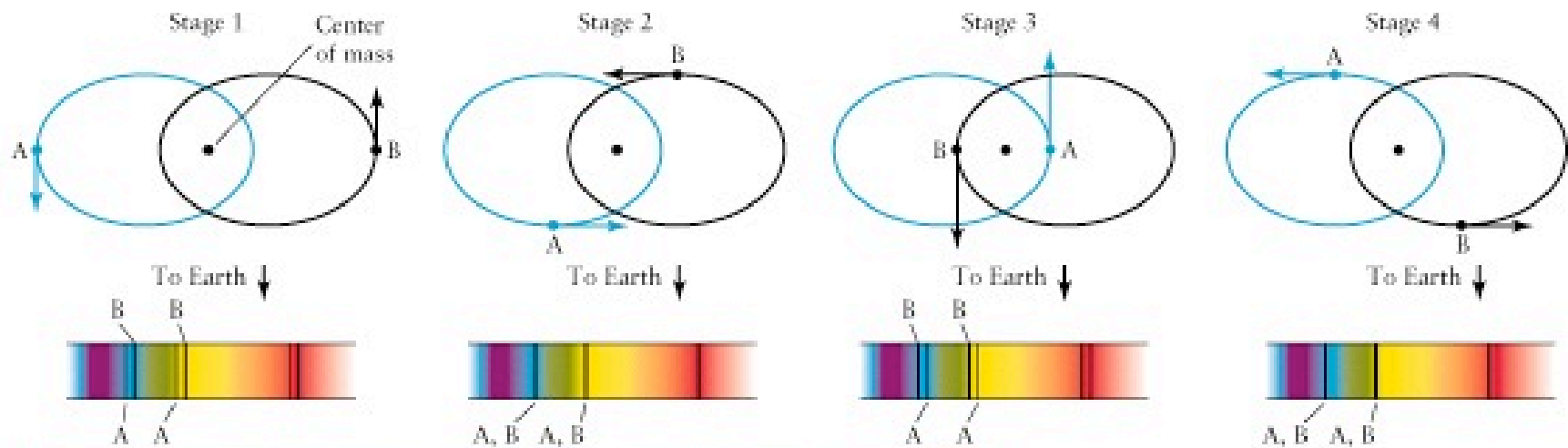




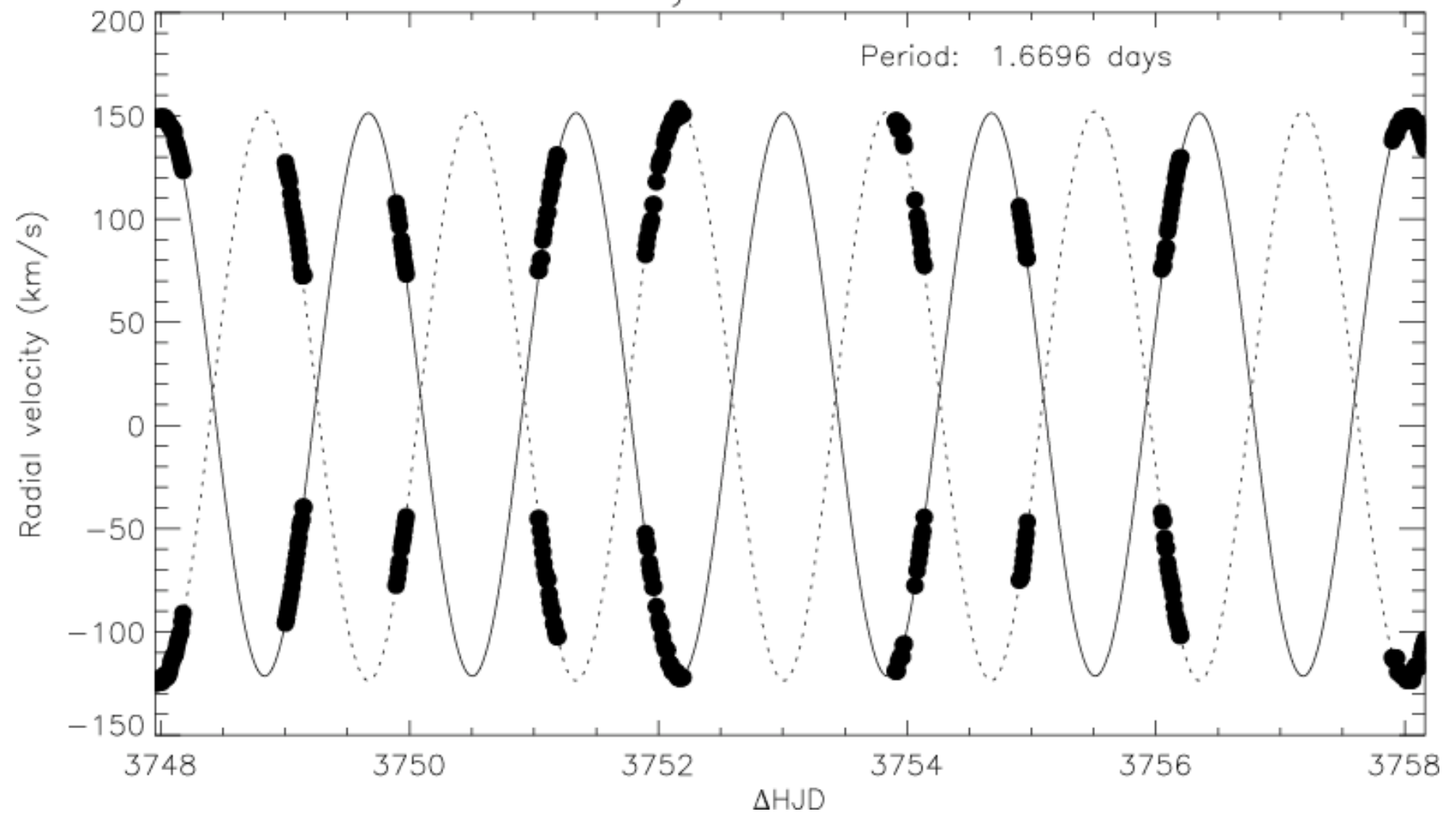






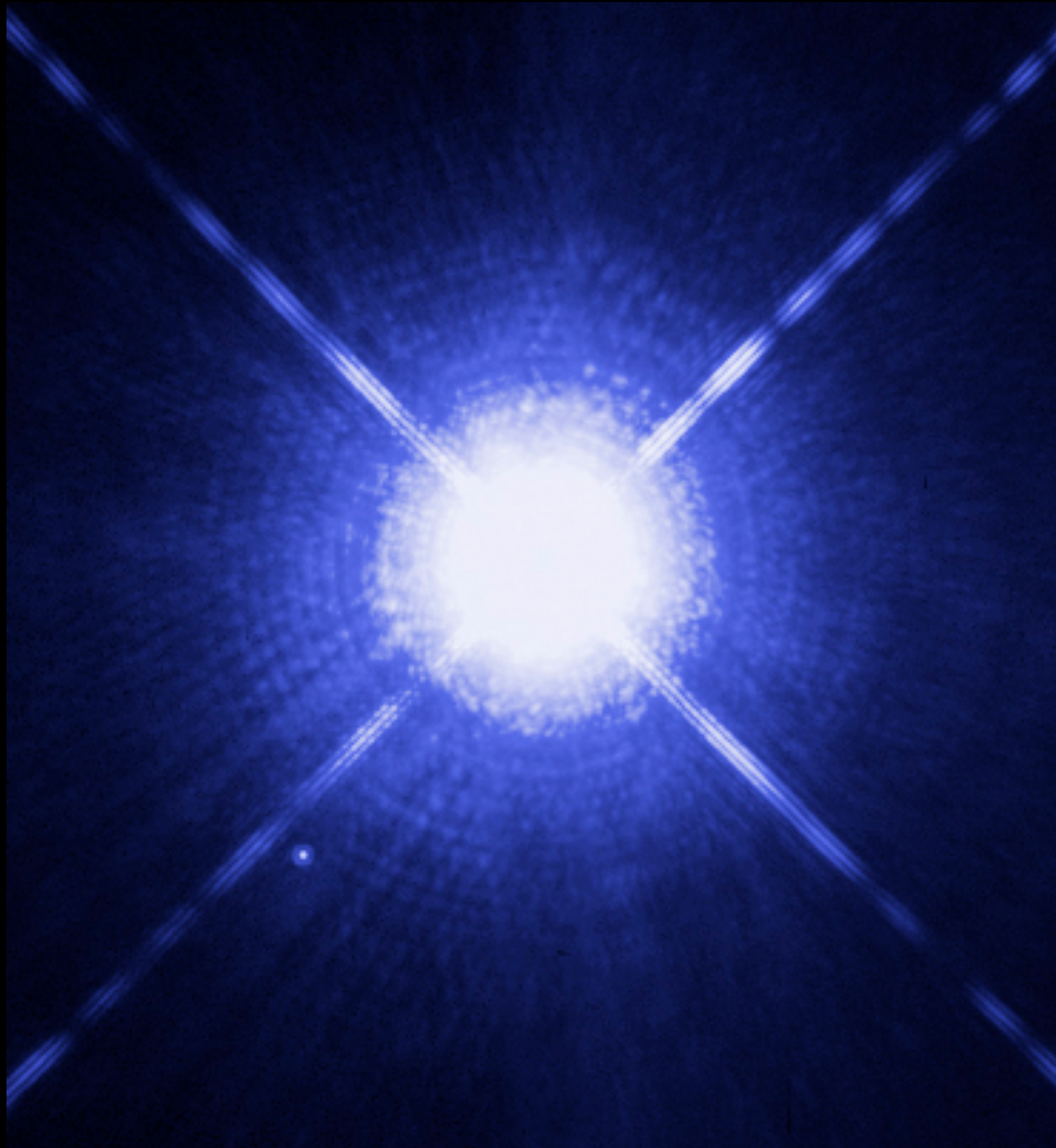


# Binary orbit of RS Cha



**Table 4.1.** Parameters of RS Cha. References: [1]  
Alecian et al., 2005, [2] Ribas et al., 2000, [3]  
Clausen & Nordstrom, 1980.

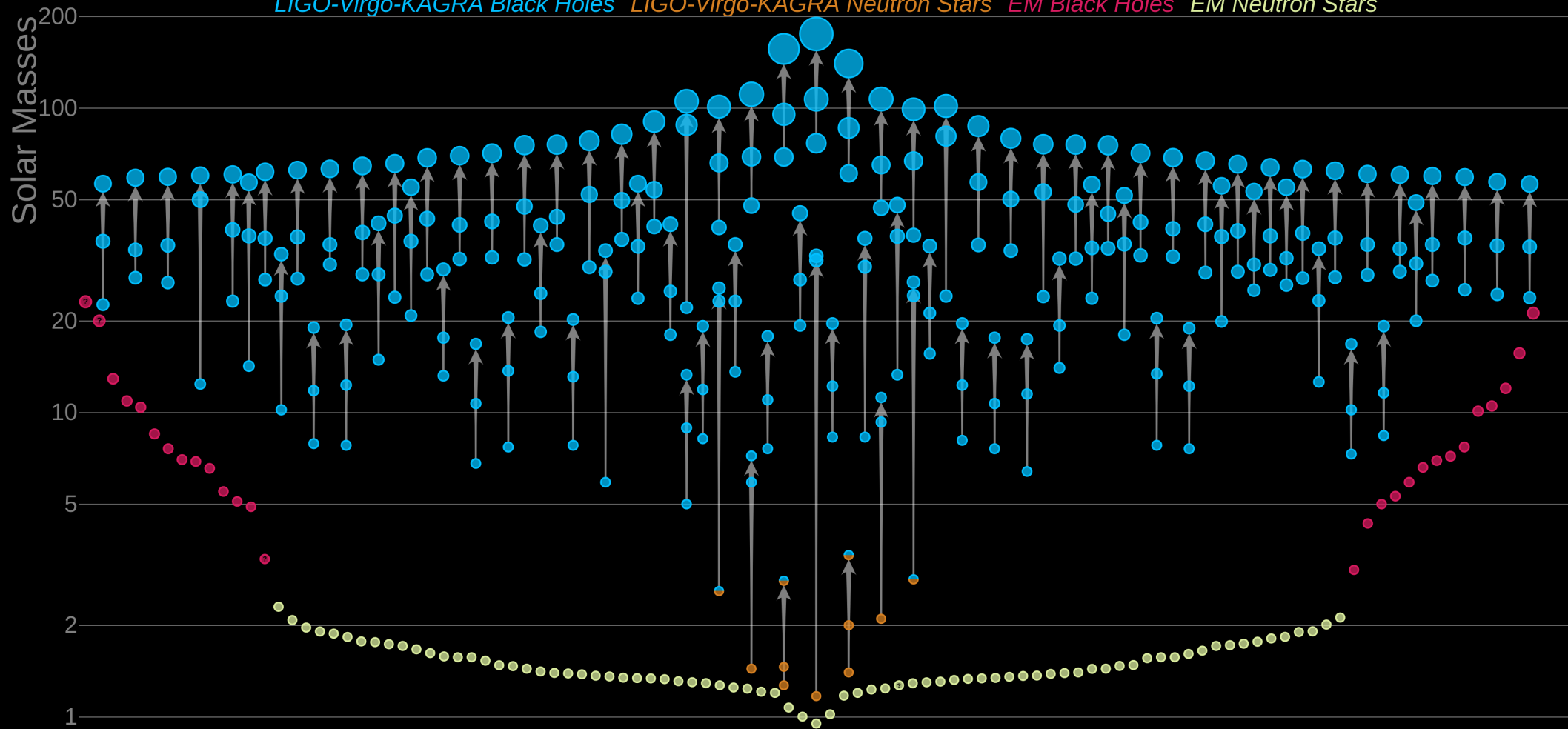
Parameter	Primary	Secondary	References
$M/M_{\odot}$	$1.89 \pm 0.01$	$1.87 \pm 0.01$	[1]
$R/R_{\odot}$	$2.15 \pm 0.06$	$1.87 \pm 0.01$	[1]
$T_{\text{eff}}$ [K]	$7638 \pm 76$	$7228 \pm 72$	[2]
$\log(L/L_{\odot})$	$1.15 \pm 0.09$	$1.13 \pm 0.09$	$L = 4\pi R^2 \sigma T_{\text{eff}}^4$
$\log(g)$ [cm s $^{-2}$ ]	$4.05 \pm 0.06$	$3.96 \pm 0.06$	$g = MG/R^2$
$v \sin i$ [km s $^{-1}$ ]	$64 \pm 6$	$70 \pm 6$	[1]
$P_{\text{orb}}$ [d]	1.67		[1]
$i$ [deg]	$83.4 \pm 0.3$		[3]
[Fe/H]	$0.17 \pm 0.01$		[1]



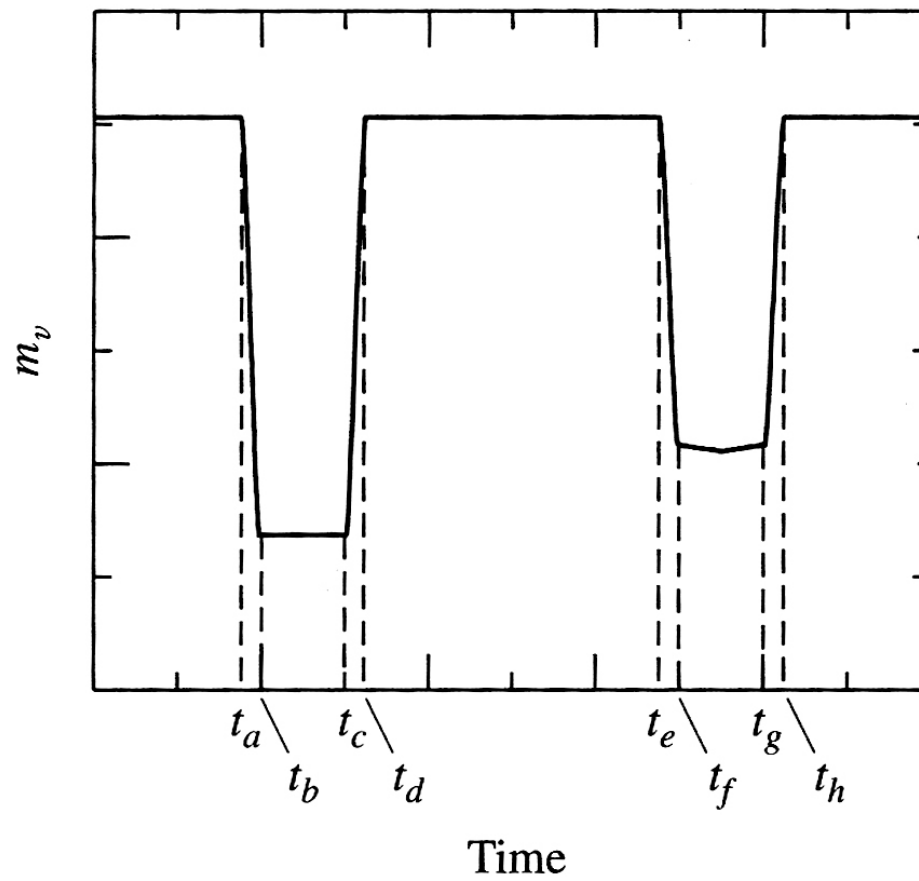
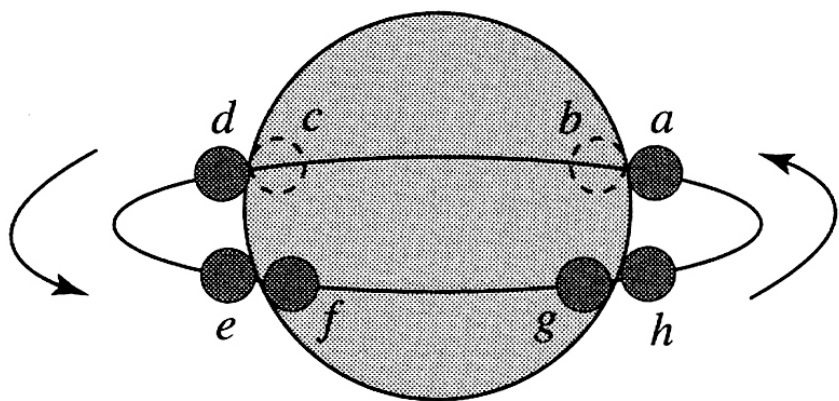


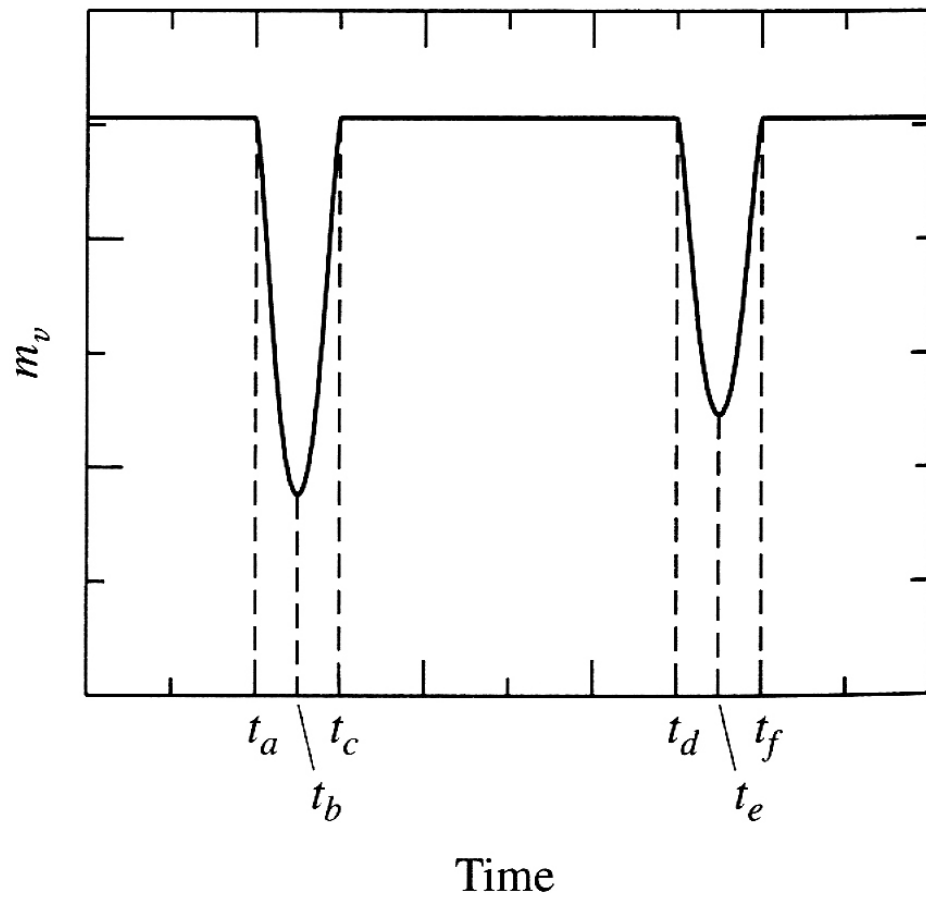
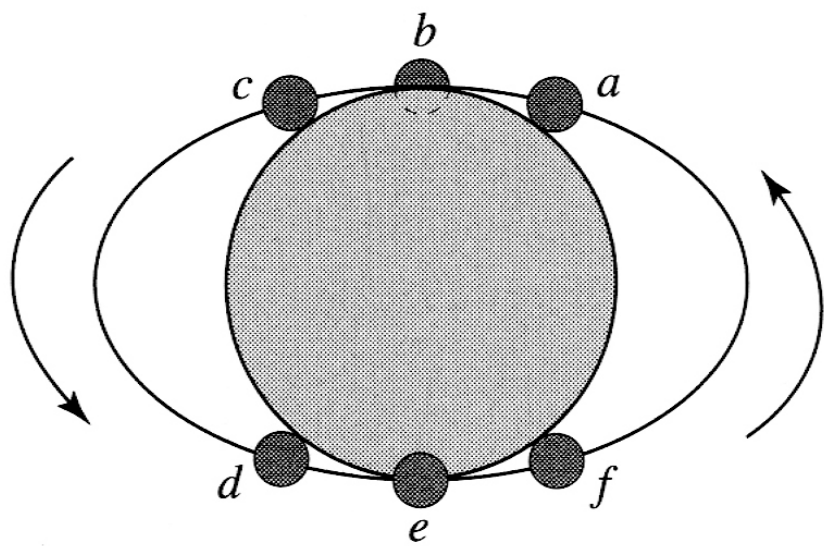
# Masses in the Stellar Graveyard

*LIGO-Virgo-KAGRA Black Holes* *LIGO-Virgo-KAGRA Neutron Stars* *EM Black Holes* *EM Neutron Stars*

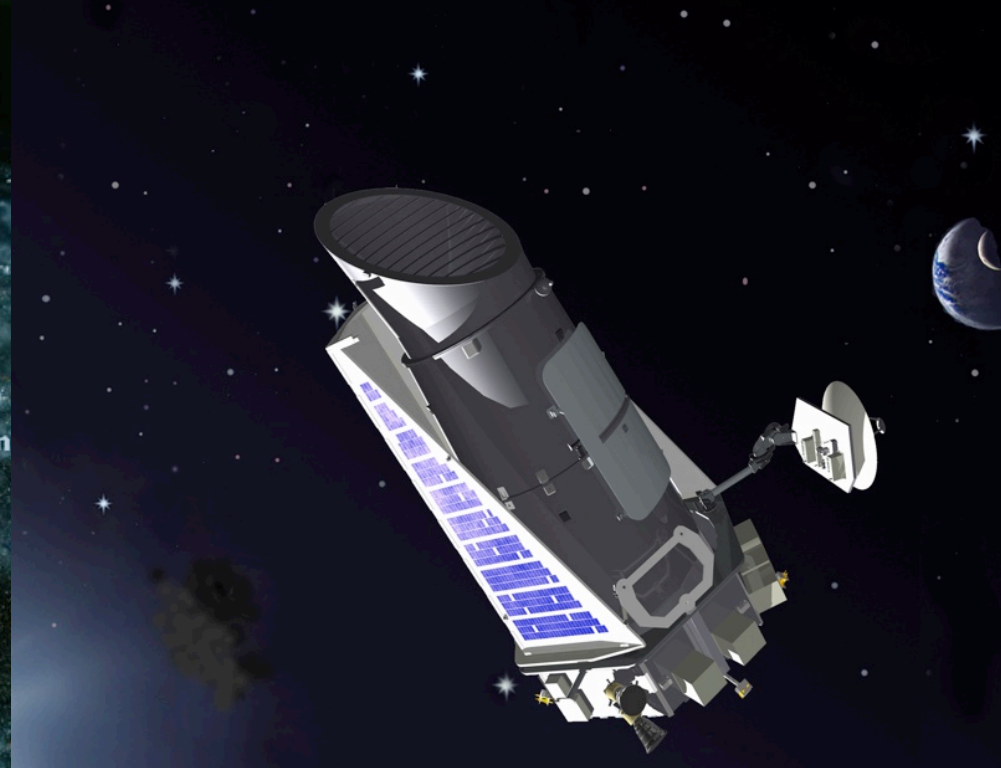
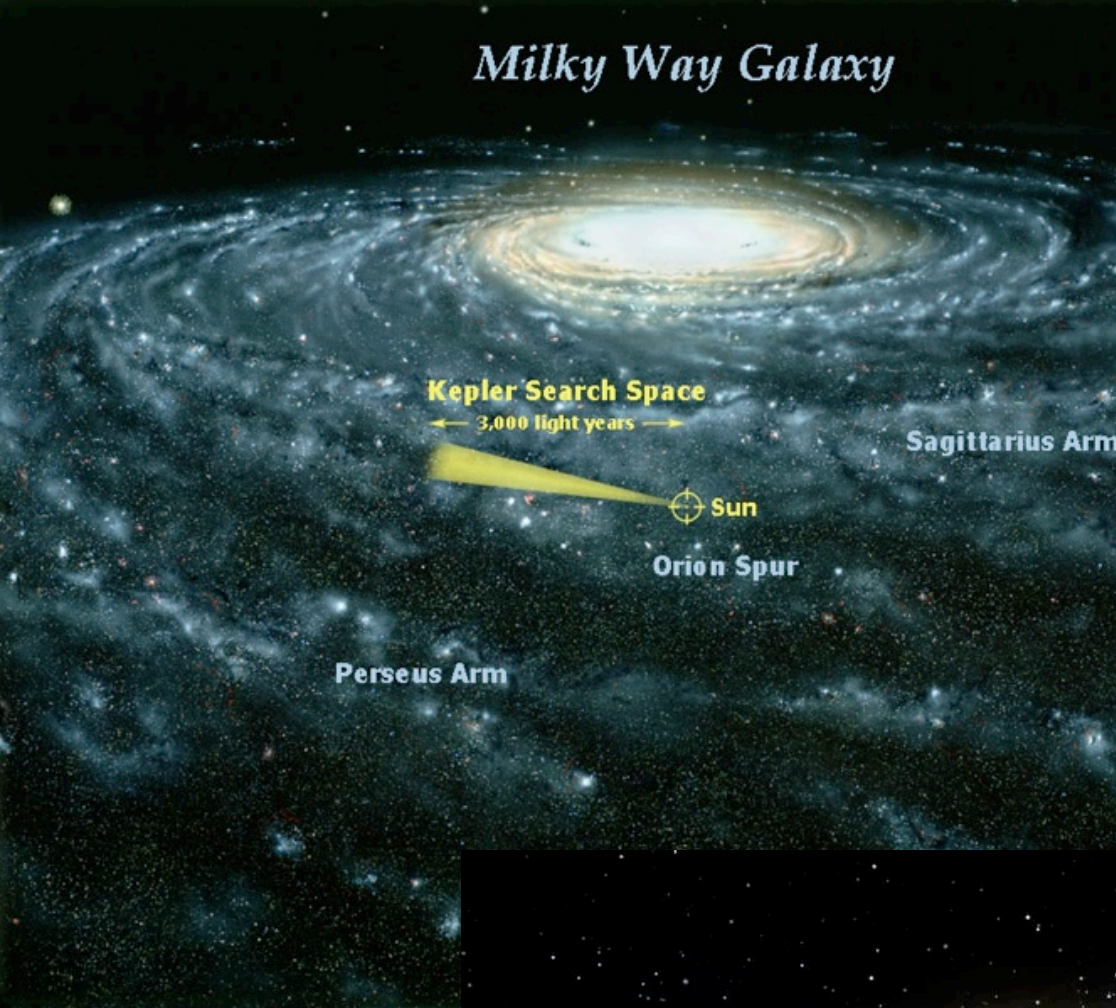


LIGO-Virgo-KAGRA | Aaron Geller | Northwestern

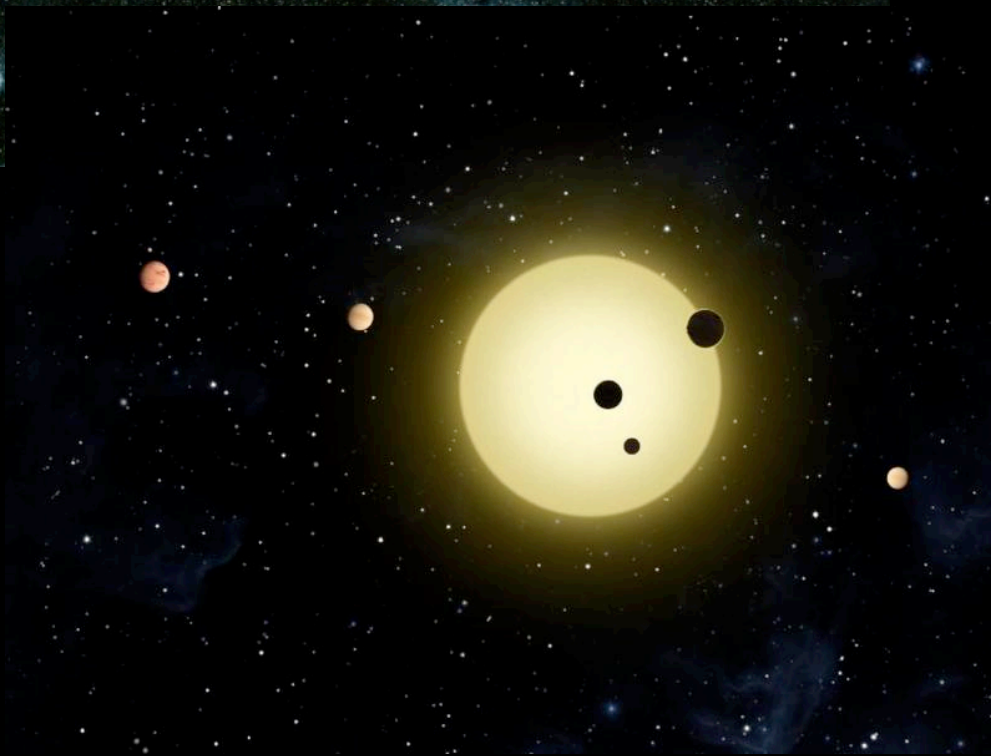




# Milky Way Galaxy

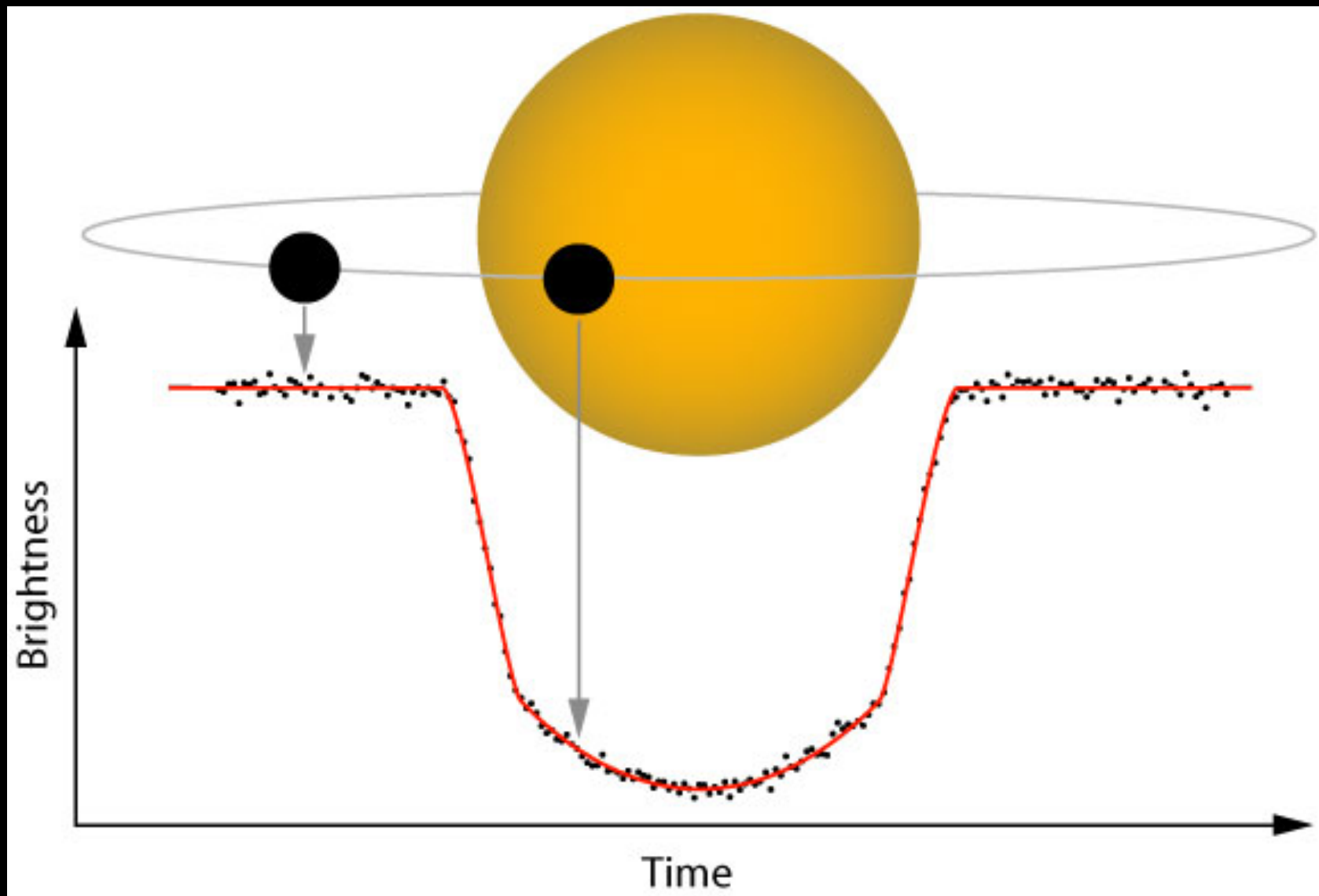


NASA

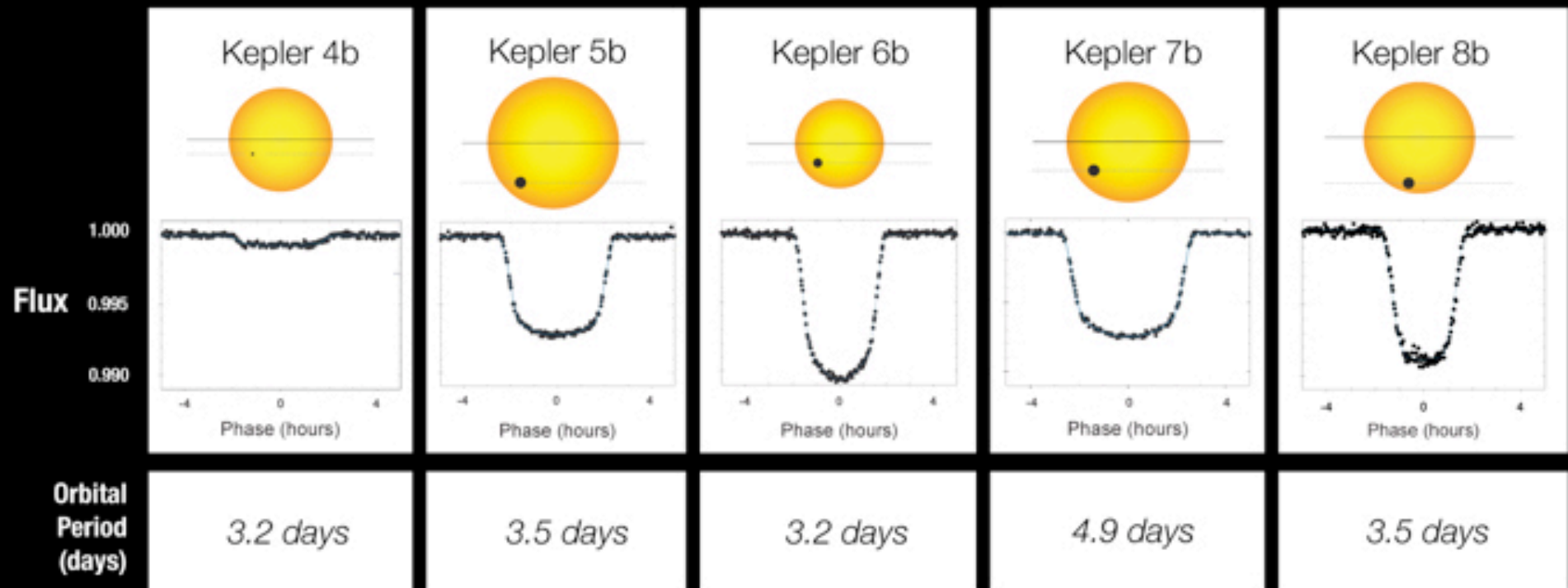


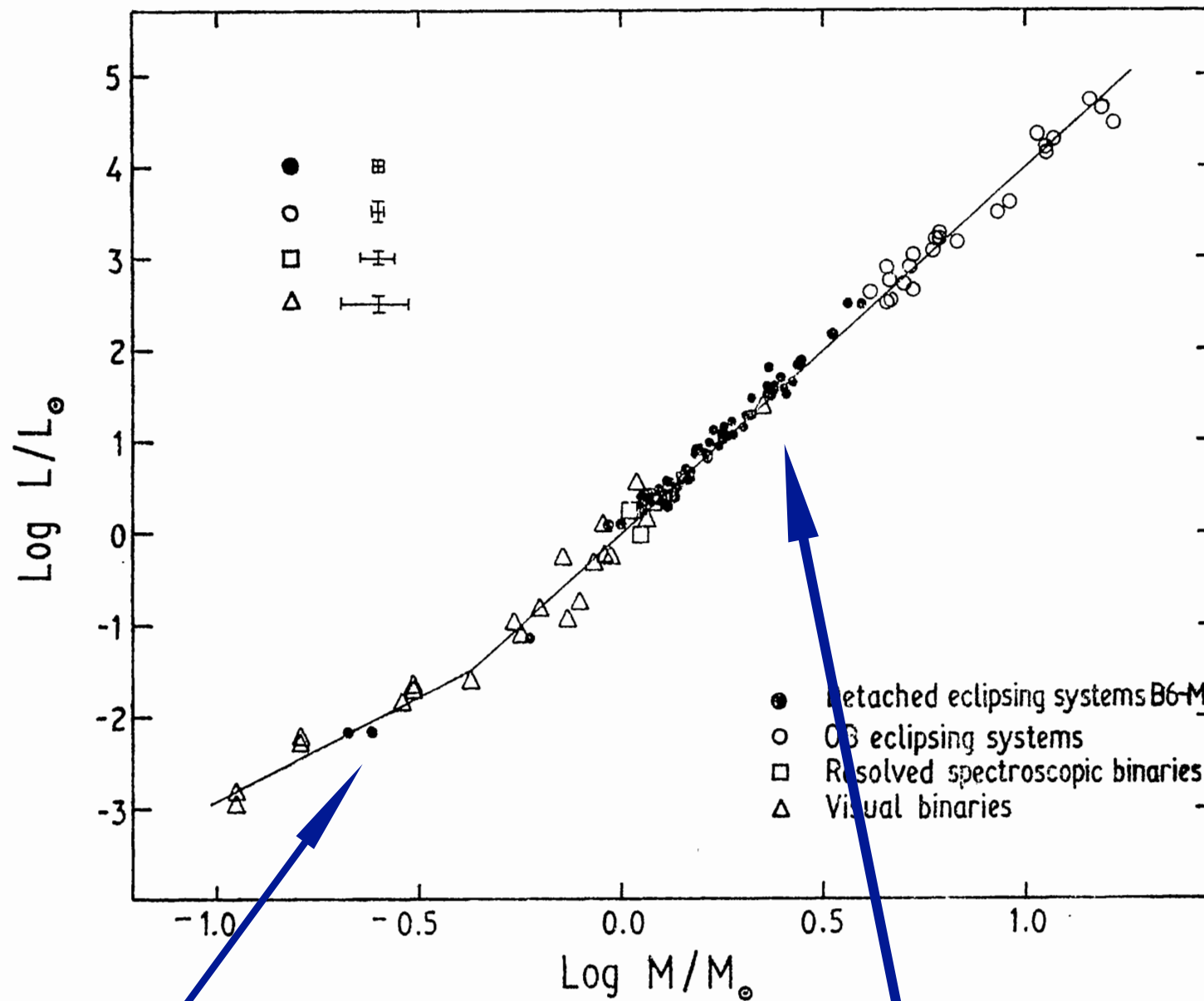
Kepler Mission





# Transit Light Curves



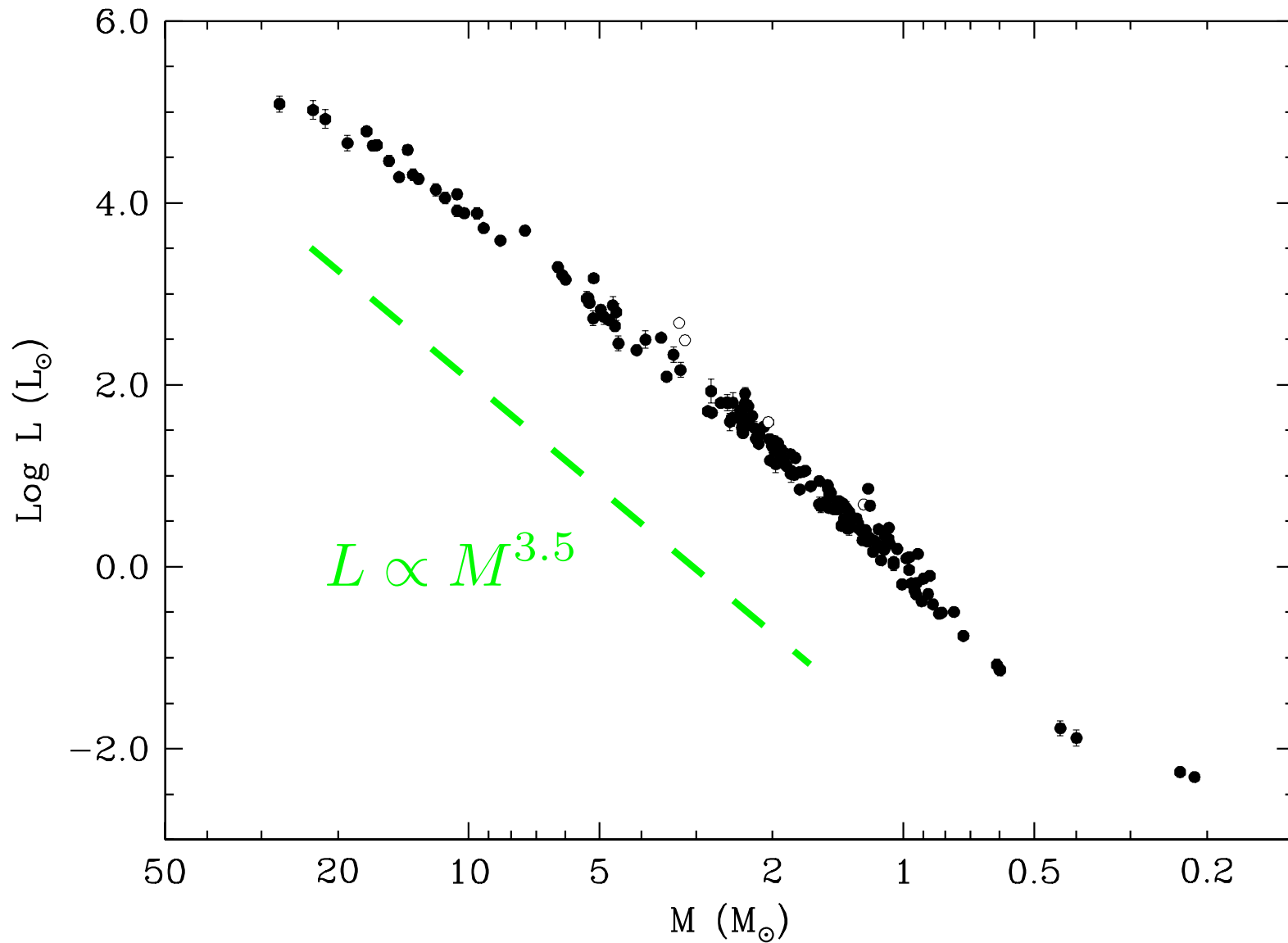


R C Smith 1983

$$\frac{L}{L_{\odot}} \propto \left( \frac{M}{M_{\odot}} \right)^{2.3}$$

$$\frac{L}{L_{\odot}} \propto \left( \frac{M}{M_{\odot}} \right)^4$$

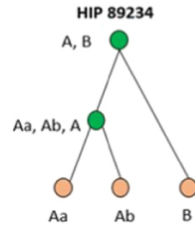
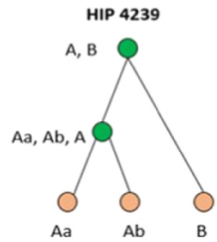
Mass-Luminosity relation for 190 stars in 95 detached binary systems  
whose radii and masses are known to better than 3%



Torres et al. 2010

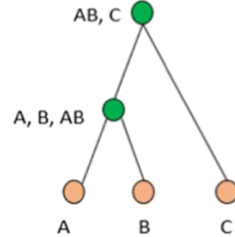


## Triple Systems

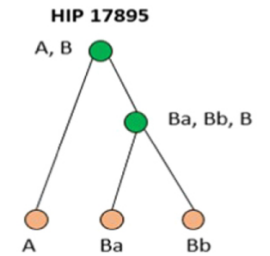
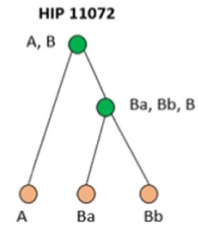
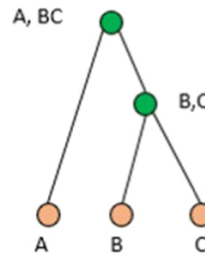


Triple  
A, B, C

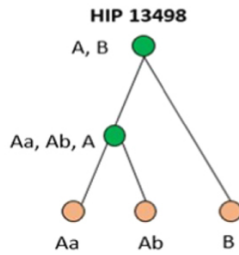
**HIP 51255**



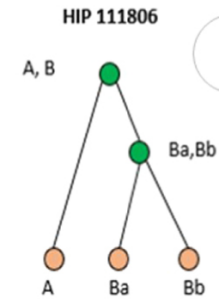
**HIP 54611**



Triple  
Aa, Ab, B

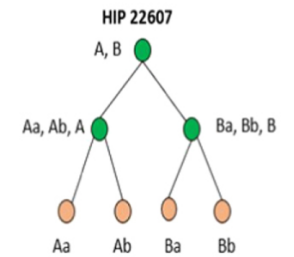
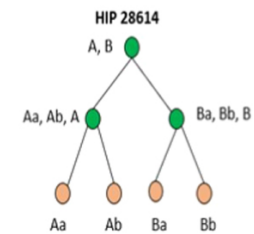
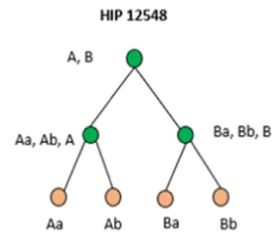
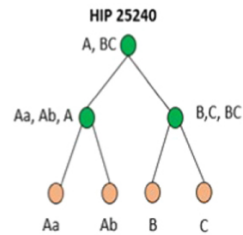
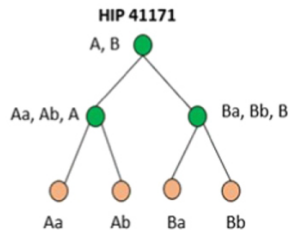


Triple  
A, Ba, Bb



Subsystems  
Individual stars

## 2+2 Quadruple Systems



## 3+1 Quadruple Systems

