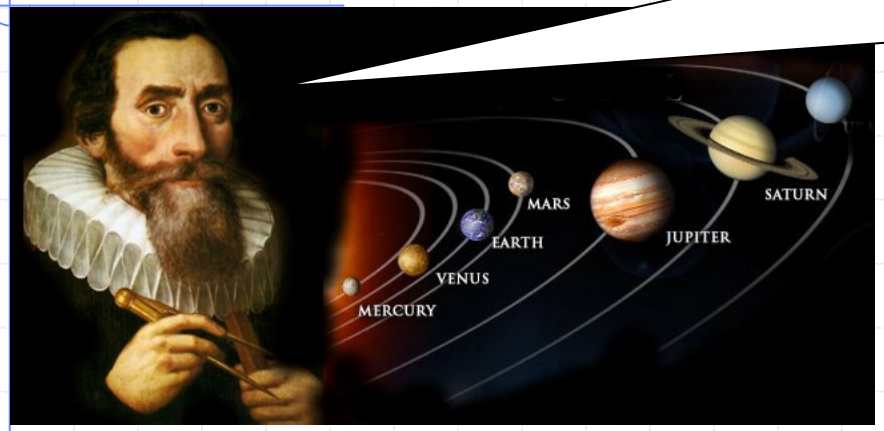
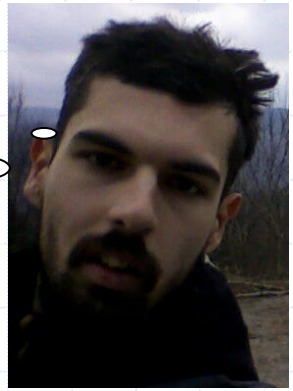
# Johannes Kepler (1571. – 1630.)

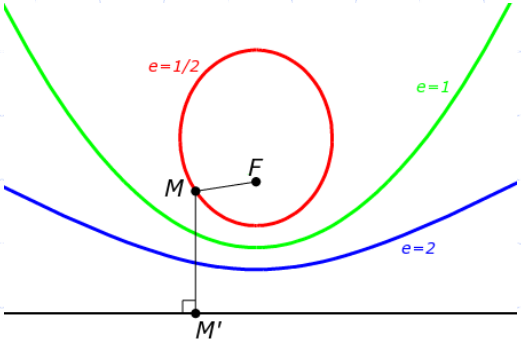


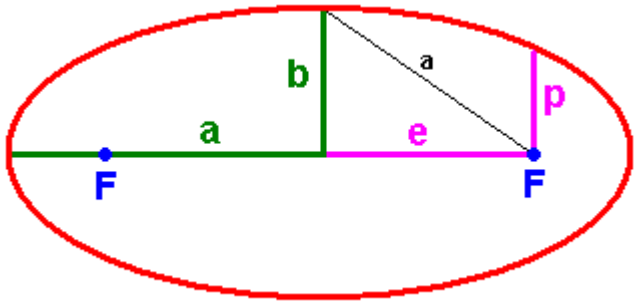

Planeti se gibaju po eliptičnim putanjama sa Suncem u jednom od fokusa.


**Petar Žugec**
**1987. → ∞**



$$r = \frac{p}{1 + e\cos\theta}$$



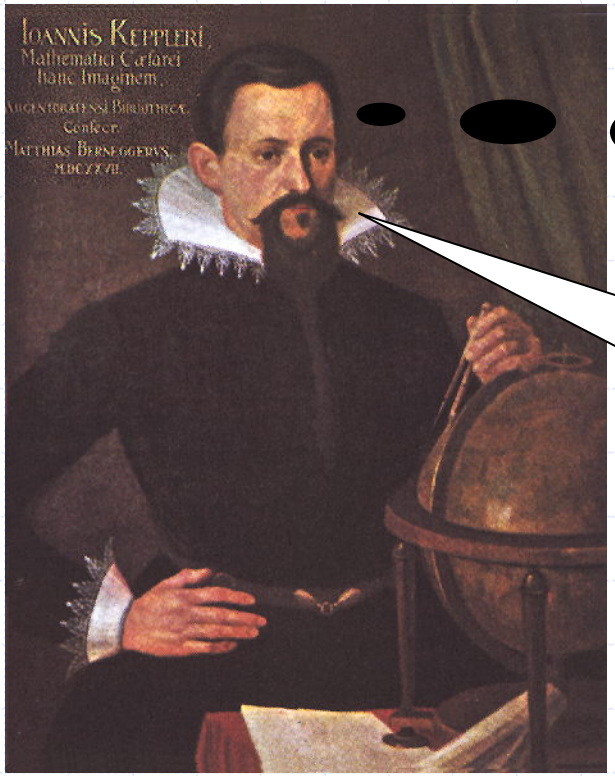

$e < 1 \rightarrow$ *elipsa*

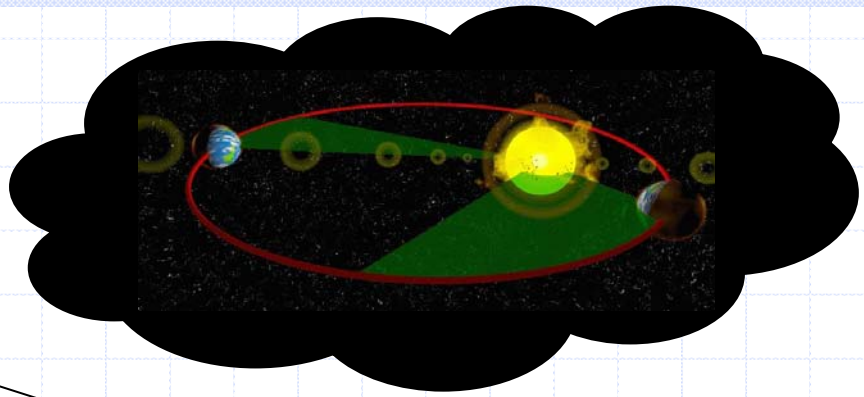
$e = 1 \rightarrow$ *parabola*

$e > 1 \rightarrow$ *hiperbola*

$$e = \sqrt{1 - \frac{2L^2|E|(M+m)}{G^2M^3m^3}} \qquad p = \frac{L^2(M+m)}{GM^2m^2}$$

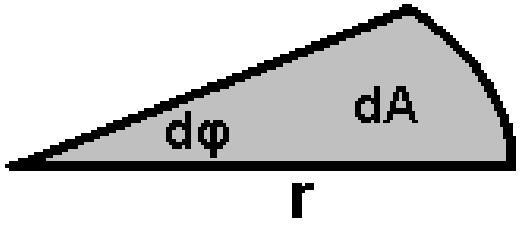
$$a = \frac{GMm}{2|E|} \qquad b = L\sqrt{\frac{(M+m)}{2Mm|E|}}$$



Spojnica planet-Sunce u jednakim vremenskim intervalima prebrisuje jednake površine.

Gravitacija – centralna sila: $\vec{F} = F\hat{r}$




$$\vec{M} = \frac{d\vec{L}}{dt} = \vec{r} \times \vec{F} = 0$$

$$L = \mu r^2 \omega = const.$$

$$dA = \frac{1}{2} r^2 d\varphi$$

$$\frac{dA}{dt} = \frac{r^2}{2}\frac{d\varphi}{dt} = \frac{L}{2\mu} = const.$$

Kvadrat perioda ophoda planeta oko Sunca proporcionalan je kubu njihovih udaljenosti.

$$T\frac{dA}{dt} = P \quad \Rightarrow \quad T\frac{L}{2\mu} = ab\pi$$

$$\left.\begin{aligned} a &= \frac{GMm}{2|E|} \\ b &= L\sqrt{\frac{(M+m)}{2Mm|E|}} \end{aligned}\right\} \quad T^2 = \frac{4\pi^2}{G(M+m)}a^3$$

## Laplace-Runge-Lenzov vektor

$$\vec{A} = \vec{p}\times\vec{L} - GMm^2\hat{r}$$

konstanta gibanja