NYU Physics I — 2017-11-21

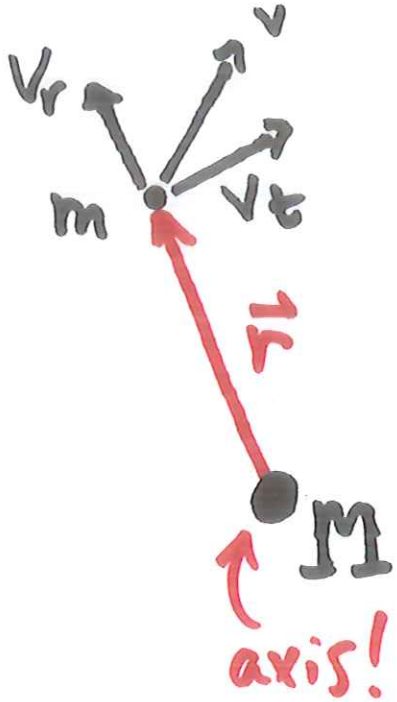
Agenda — Reading — N. gravity — a, e / L, E

— $\frac{G M m}{r^2}$ — K's laws

— Questions.

— Transfer orbit.

$$I\omega = \cancel{M} mr^2 \cdot \frac{v_t}{r} = m v_t r$$



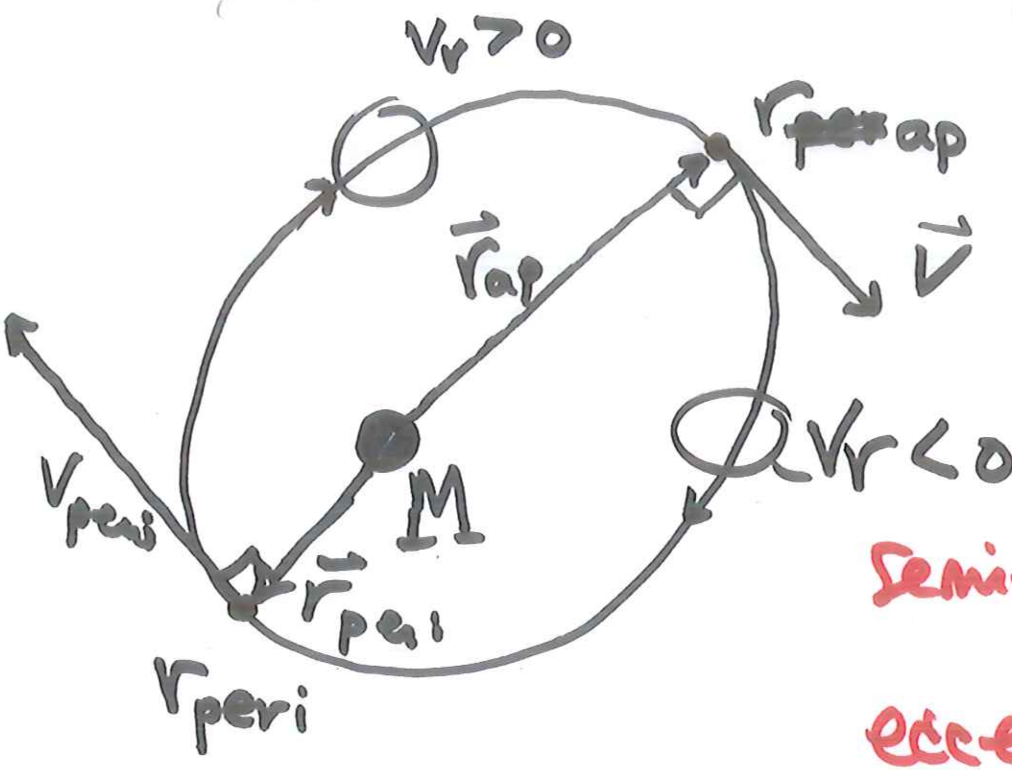
$$L = m v_t r \quad \left(= \vec{r} \times \vec{p} \right)$$

invariant — <u>no</u> torque

$$E = \frac{1}{2} m v_r^2 + \frac{1}{2} m v_t^2 - \frac{GMm}{r\,\text{[redacted]}}$$ [redacted] = 1

invariant! — no external <u>work</u>

$$E = \underbrace{\frac{1}{2} m v_r^2}_{\text{only on } v_r!} + \underbrace{\underbrace{\frac{L^2}{2mr^2} - \frac{GMm}{r}}_{\text{depends only on } r!}}_{\text{effective potential}}$$



@ r_{ap}, r_{peri}:

$$r^2 E = \frac{L^2}{2m} - GMm\,r$$

semi-major axis: ${}_{sm}a \equiv \frac{r_{ap} + r_{peri}}{2}$

eccentricity $e \equiv \frac{r_{ap} - r_{peri}}{r_{ap} + r_{peri}}$

$$r_{\substack{ap\\peri}} = \frac{-\text{"b"} \pm \sqrt{\text{"b"}^2 - 4\text{"a"}\text{"c"}}}{2\text{"a"}}$$

"a": E

"b": GMm

"c": $-\frac{L^2}{2m}$

$${}_{sm}a = \frac{-\text{"b"}}{2\text{"a"}} = \frac{-GMm}{2E}$$

not responsible for a–"a" confusion.

sma $a = \frac{-GMm}{2E}$ $\boxed{E = -\frac{GMm}{2a}}$

total energies of <u>bound</u> planets are <u>negative</u>

if $E > 0$, you aren't bound.

$T_E \equiv 1\ \text{yr}$

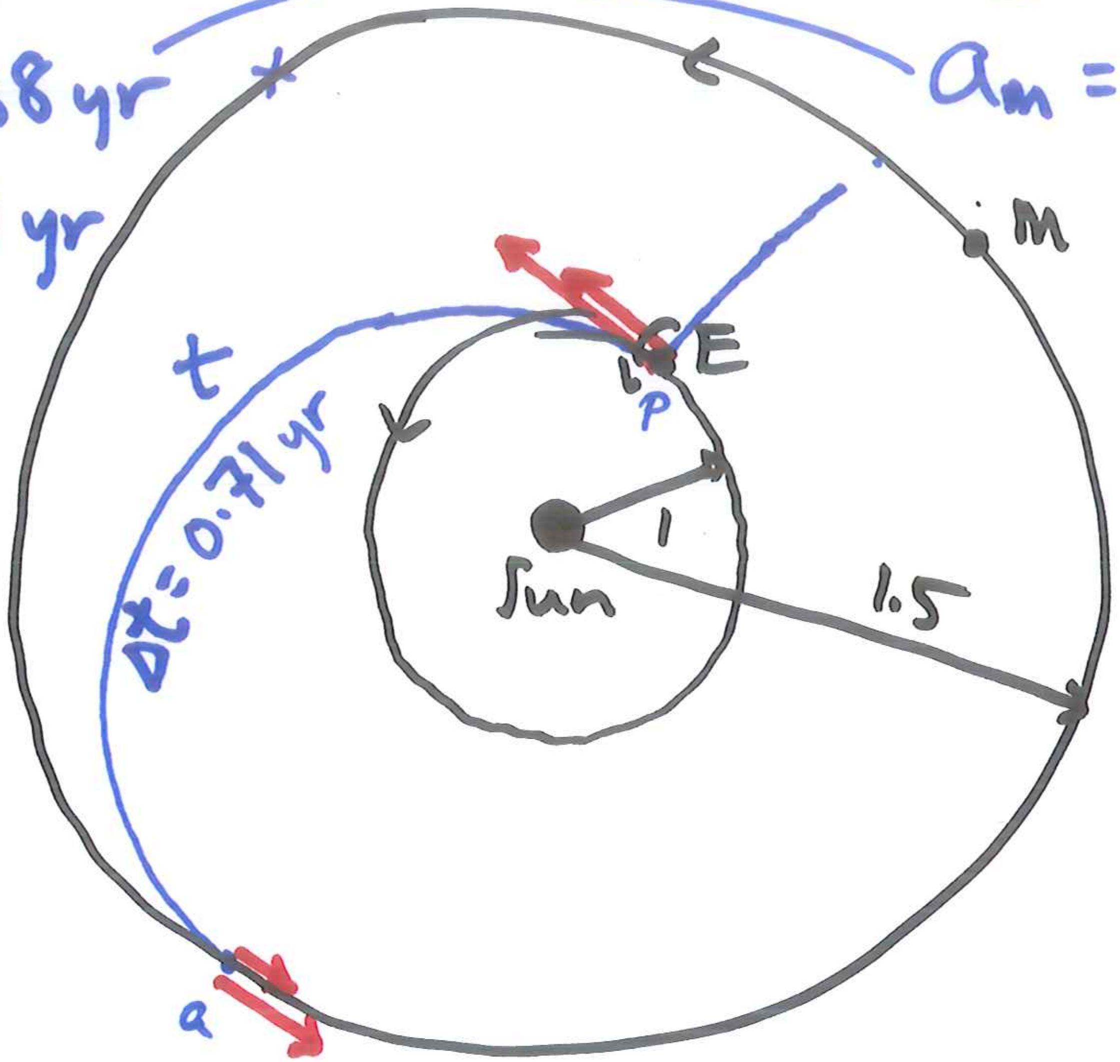
$T_m = 1.88\ \text{yr}$

$T_t = 1.41\ \text{yr}$

$T^2 \propto a^3$

$a_E \equiv 1\ \text{AU}$

$a_m = 1.52\ \text{AU}$



$$a_t = \frac{r_{ap} + r_{peri}}{2}$$

$$= \frac{1.52\ \text{AU} + 1\ \text{AU}}{2}$$

$$= 1.26\ \text{AU}.$$

$$e_t = \frac{1.52 - 1}{1.52 + 1}$$

$$\sim \frac{1}{5}.$$