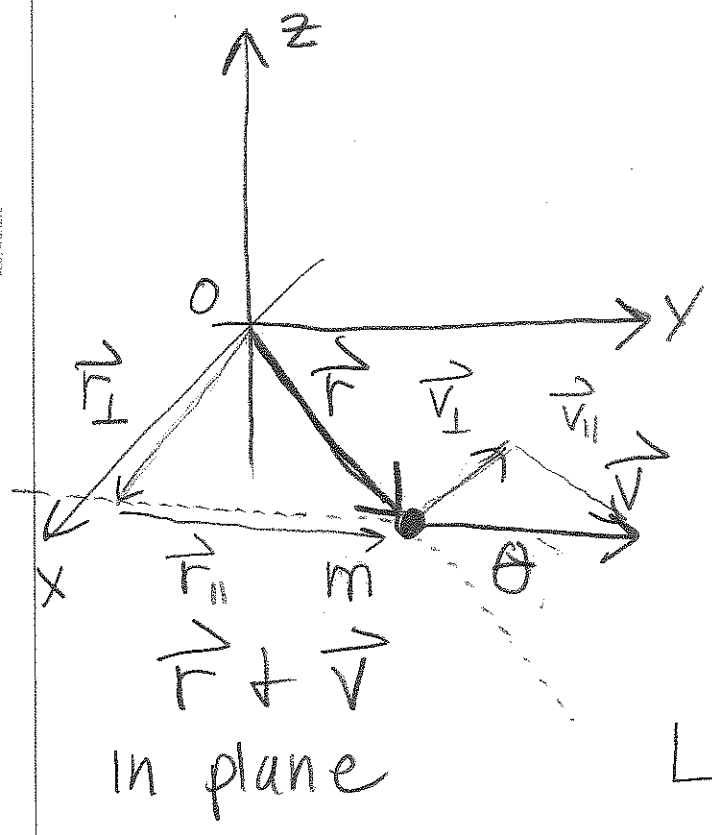


Angular Momentum

PH4 Chapter 13,
6.2-6.3 K&K

Single particle. (3-d, hard!)



$$\vec{L} = \vec{r} \times (m\vec{v})$$

$$\vec{L} = \vec{r} \times \vec{p}$$

direction: \hat{z} or \hat{k}

$$L = (r p \sin \theta) \hat{k}$$

here, $\vec{L} \parallel \vec{r} \times \vec{p} \hat{k} = r m v_{\perp} \hat{k}$ (not always true)

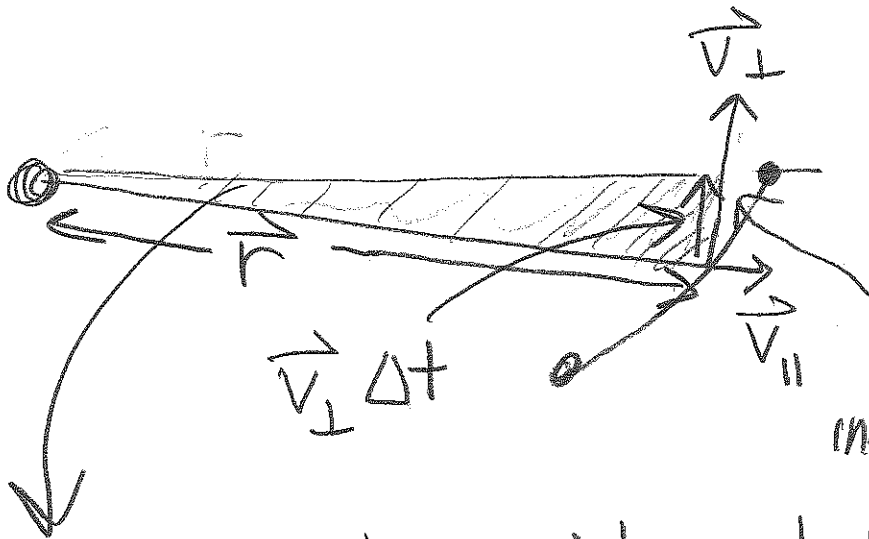
what good...

$$\frac{d\vec{L}}{dt} = \frac{d}{dt} (\vec{r} \times \vec{p})$$

$$= \frac{d\vec{r}}{dt} \times \vec{p} + \vec{r} \times \frac{d\vec{p}}{dt}$$

$$= \underbrace{\vec{v} \times m\vec{v}}_0 + \vec{r} \times \vec{F}$$

12-702 500 SHEETS, MILLER, 6 SQUARE
42-381 50 SHEETS, DIGI-CASE, 6 SQUARE
42-382 100 SHEETS, DIGI-CASE, 6 SQUARE
42-383 100 SHEETS, DIGI-CASE, 6 SQUARE
42-384 100 RECYCLED WHITE, 6 SQUARE
42-385 100 RECYCLED WHITE, 6 SQUARE
42-386 100 RECYCLED WHITE, 6 SQUARE
Made in U.S.A.



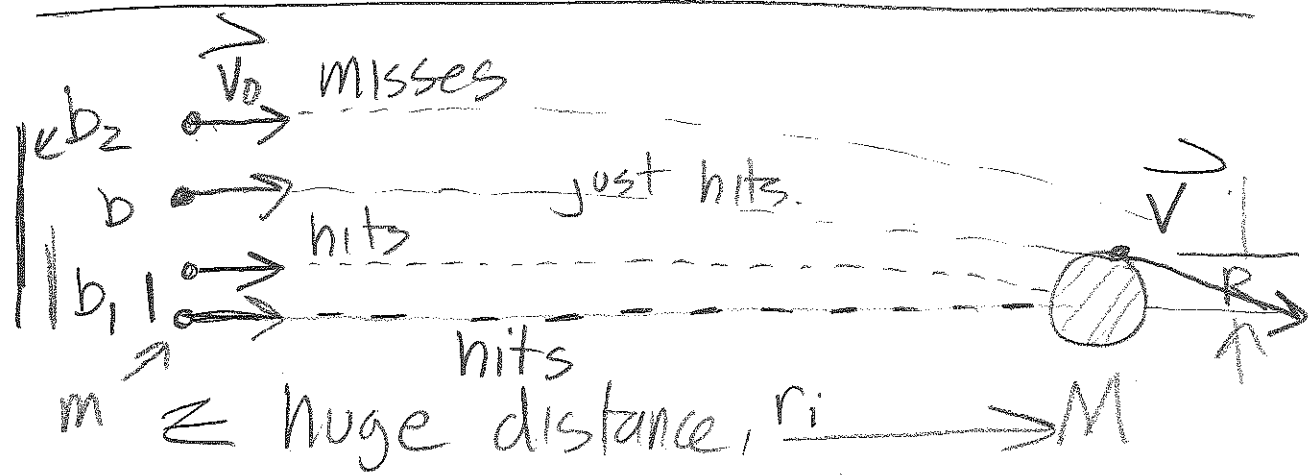
"missing" area of Δt^2 insignificant

$$\Delta A = \text{area} = \frac{1}{2} r v_{\perp} \Delta t = \frac{1}{2} \frac{L}{m} \Delta t$$

$$\frac{\Delta A}{\Delta t} \Rightarrow \frac{dA}{dt} = \frac{1}{2} \frac{L}{m} = \text{constant}$$

"Kepler's 2ND Law of Planetary Motion (Demo)"

Capture Cross Section of a Planet



19/782 500 SHEETS FULLER 5 SQUARE
 42/381 60 SHEETS FULLER 5 SQUARE
 42/382 100 SHEETS FULLER 5 SQUARE
 42/383 150 SHEETS FULLER 5 SQUARE
 42/384 200 SHEETS FULLER 5 SQUARE
 42/385 250 SHEETS FULLER 5 SQUARE
 42/386 300 SHEETS FULLER 5 SQUARE
 42/387 350 SHEETS FULLER 5 SQUARE
 42/388 400 SHEETS FULLER 5 SQUARE
 42/389 450 SHEETS FULLER 5 SQUARE
 42/390 500 SHEETS FULLER 5 SQUARE
 42/391 550 SHEETS FULLER 5 SQUARE
 42/392 600 SHEETS FULLER 5 SQUARE
 42/393 650 SHEETS FULLER 5 SQUARE
 42/394 700 SHEETS FULLER 5 SQUARE
 42/395 750 SHEETS FULLER 5 SQUARE
 42/396 800 SHEETS FULLER 5 SQUARE
 42/397 850 SHEETS FULLER 5 SQUARE
 42/398 900 SHEETS FULLER 5 SQUARE
 42/399 950 SHEETS FULLER 5 SQUARE
 42/400 1000 SHEETS FULLER 5 SQUARE
 Made in U.S.A.

$$b > R$$

like planet has "bigger cross-section"

$$\pi b^2 > \pi R^2$$

$$L = m v_0 b \quad \text{CONSERVED}$$

$$= m v R$$

solve for b ,
need v !

Energy:

$$\frac{1}{2} m v_0^2 - \frac{GMm}{r_i} = \frac{1}{2} m v^2 - \frac{GMm}{R}$$

\downarrow
 r_i

$$\text{let } r_i = \infty$$

$$\frac{1}{2} m v^2 = \frac{1}{2} m v_0^2 + \frac{GMm}{R}$$

$$v^2 = v_0^2 + \frac{2GM}{R}$$

$$b = \frac{v}{v_0} R$$

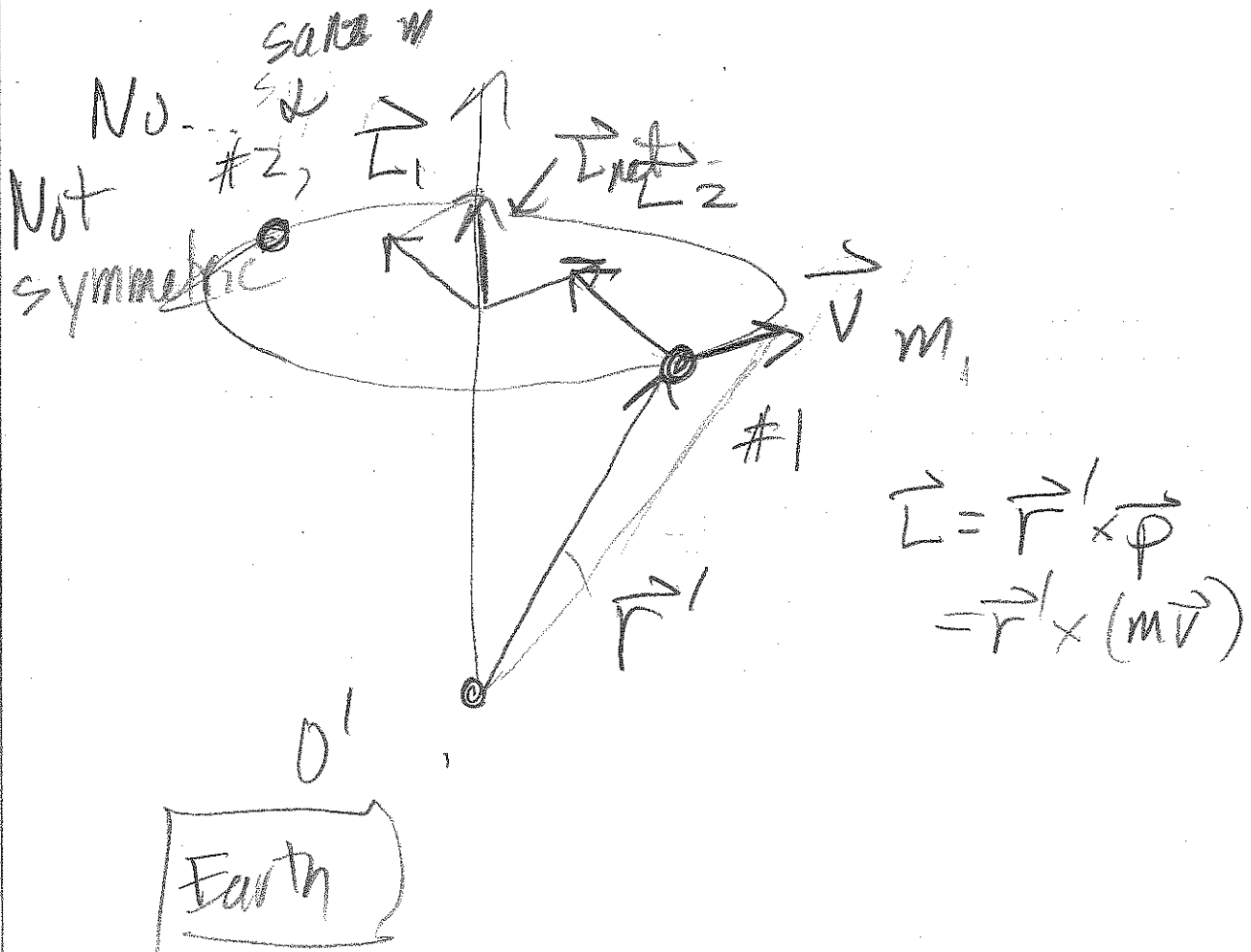
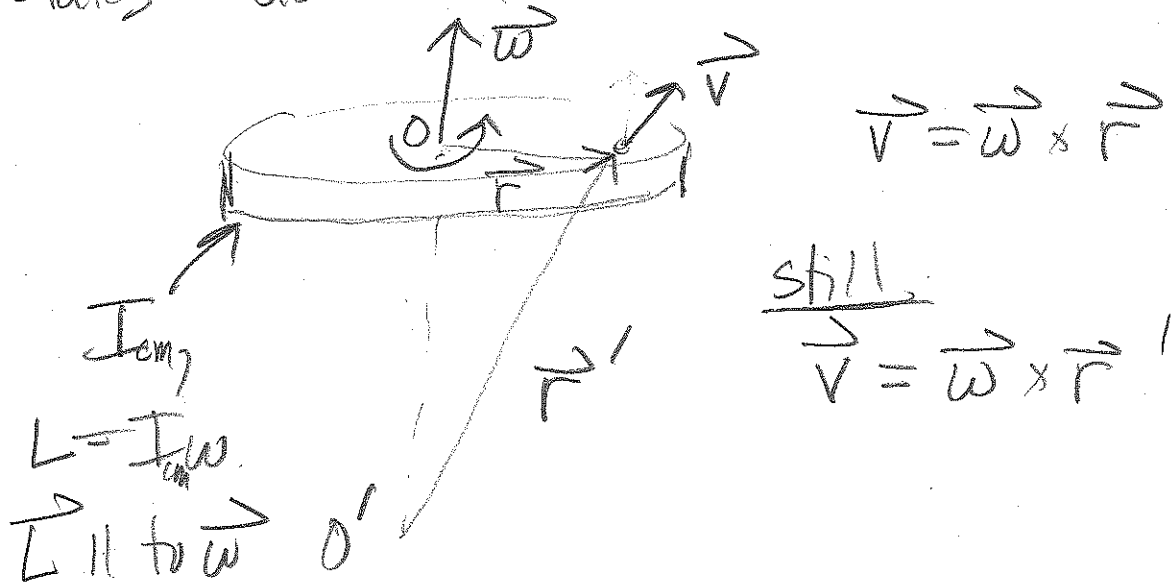
$$b = \left[1 + \frac{2GM}{R v_0^2} \right]^{1/2} R$$

note: $v_{esc}^2 = \frac{2GM}{R}$

$$b = \left[1 + \left(\frac{v_{esc}}{v_0} \right)^2 \right]^{1/2} R, \quad A = \pi b^2 = \left[1 + \left(\frac{v_{esc}}{v_0} \right)^2 \right] \pi R^2$$

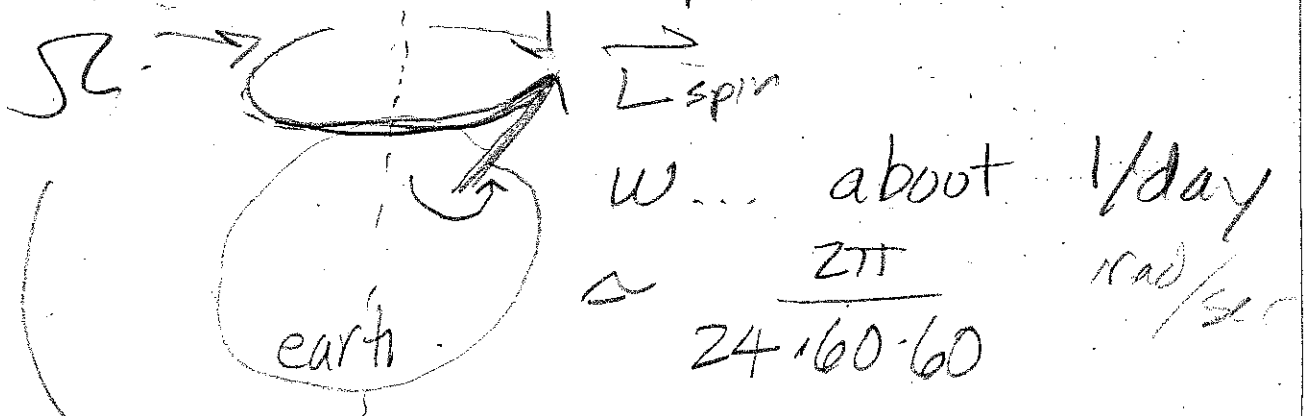
Is $\vec{\omega} \parallel \vec{L}$?

Yes when a symmetric object rotates about its center.



Earth Precession

Takes $\approx 26,000$ years for
a complete round trip



$$\Omega \approx \frac{2\pi}{26,000 \text{ years}}$$

Our year ("tropical") is
 \approx winter solstice to } growing
 winter solstice } seasons

$\neq 2\pi$ in azimuth about
sun, due to precession!

Capricorn

Sagittarius

Scorpio



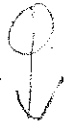
Aquarius

Libra

Pisces



equinox



Aries

March

Leo



Earth spin

Feb

Jan 1

Cancer

W solstice
GEMINI

Taurus

(constellation)