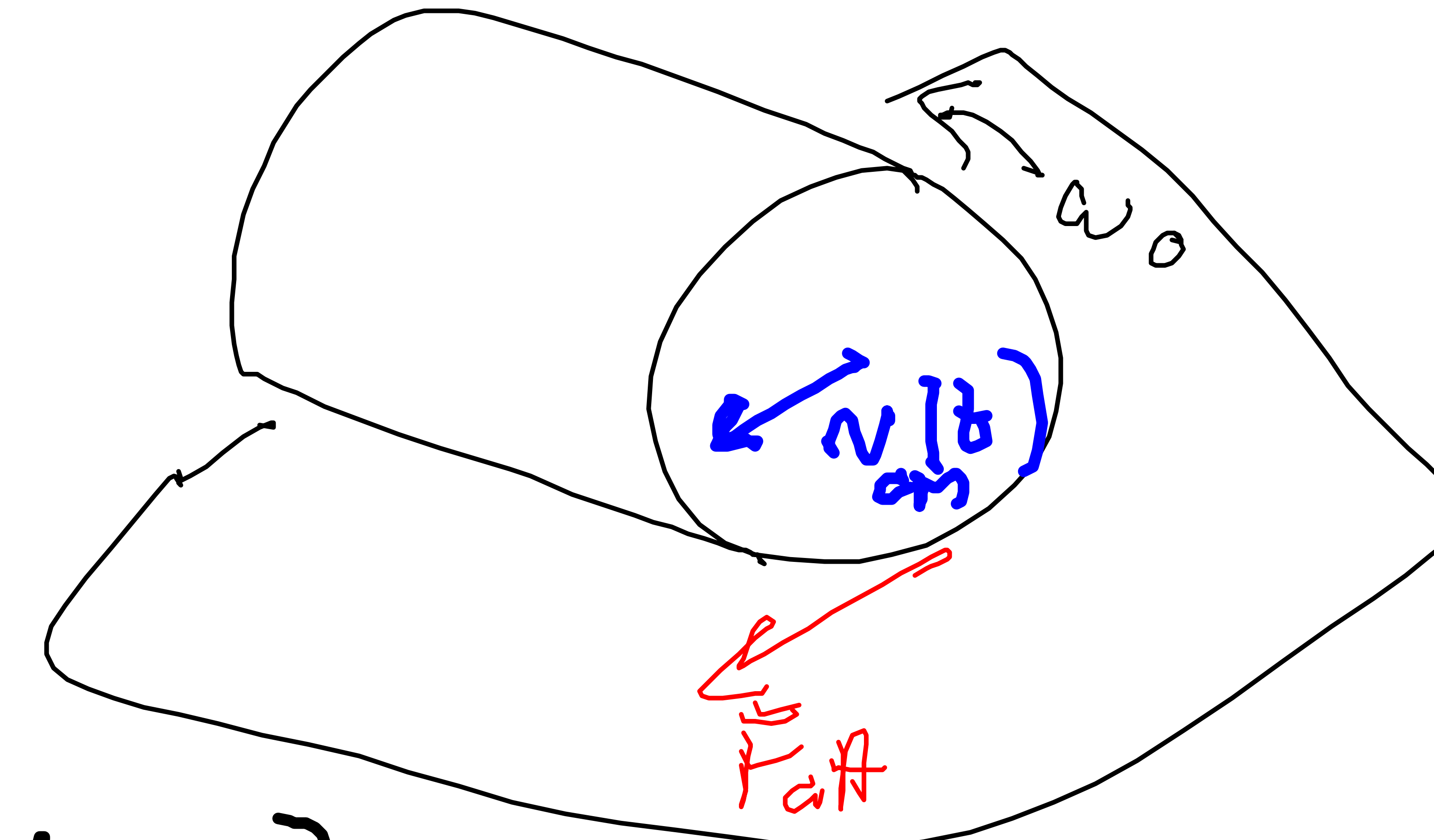
Cilindro pieno



$R = 15\ cm$, $M = 2\ kg$, $\omega_0 = 40\ rad/s$

$\mu_d = 0.25$

a) $t' = \dfrac{\omega_0 R}{3\mu g} = 0.82\ s$

b) $v(t') = ?$ c) N giri at t' d) energia dissipata $= ?$

$$\alpha = \mu M g \frac{R}{I} = \frac{2\mu_d g}{R} = 32.7\ rad/s = \frac{a_{cm}}{R}$$

$$v_{cm}(t') = a_{cm}\, t' = \alpha R t' = 2.0\ m/s^2$$

$$\begin{cases} \omega(t) = \omega_0 - \alpha t \\ \vartheta(t) = \vartheta_0 + \omega_0 t - \frac{1}{2}\alpha t^2 = 21.8\ rad \end{cases}$$

$$N = \frac{\vartheta(t')}{2\pi} = 3.47\ \text{giri}$$

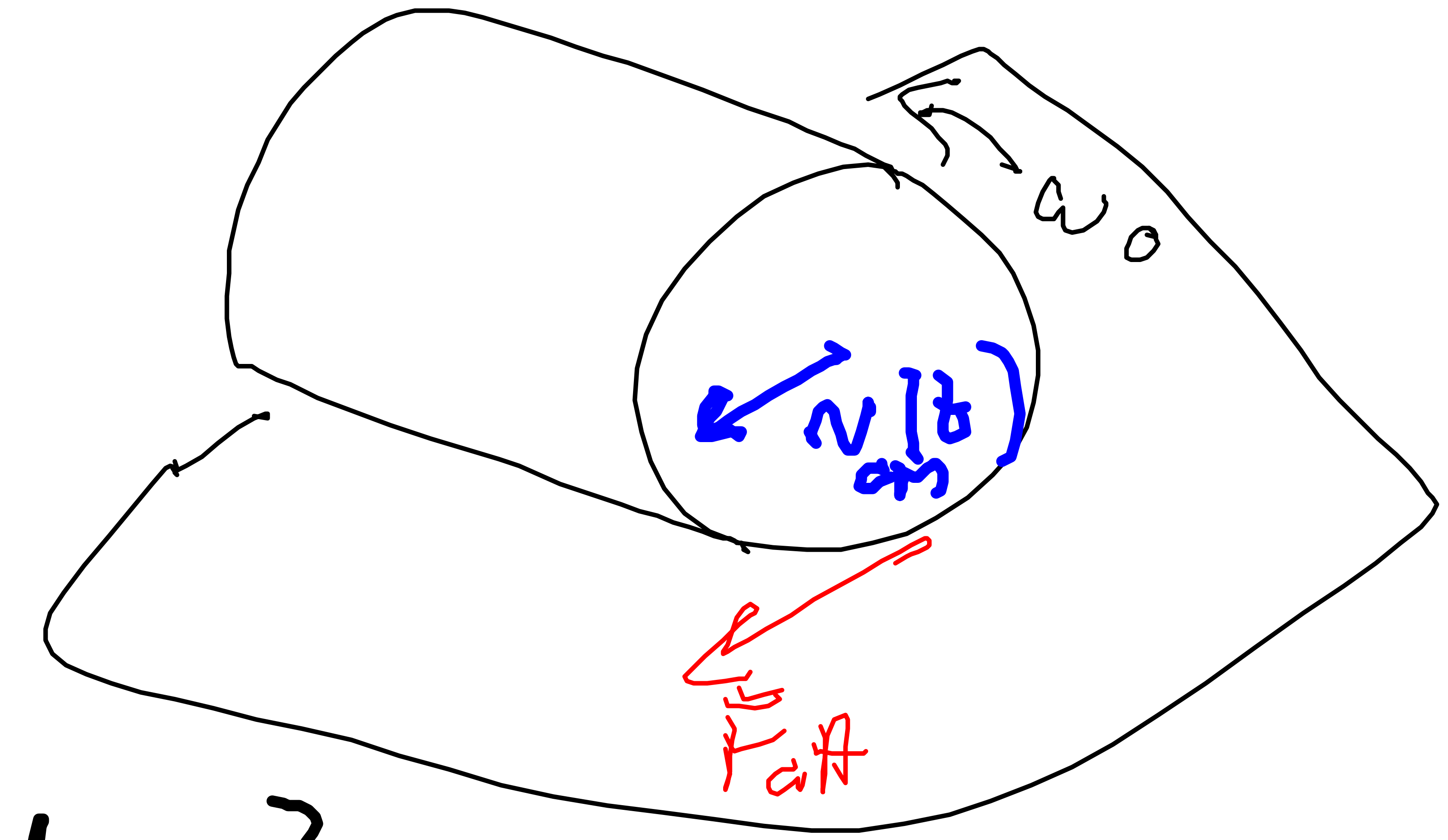
Cilindre plene

$R = 15\,cm$, $m = 2\,kg$, $\omega_0 = 40\,rad/s$

$\mu_d = 0.25$

a) $t' = \dfrac{\omega_0 R}{3\mu g} = 0.82\,s$

b) $v(t') = ?$ c) N giri at t' d) energia dissipata = ?



$$K_i = K_i^{rot} = \frac{1}{2} I \omega_0^2 = \frac{1}{2}\frac{1}{2} m R^2 \omega_0^2 = 18\,J$$

$$E^{diss} = K_i - K_f = 12\,J$$

$$K_f = K_f^{rot} + K_f^{tr.} = \frac{1}{2} I \omega^2(t') + \frac{1}{2} m v_{cm}^2(t')$$

$$= \frac{1}{2}\frac{1}{2} m \underbrace{R^2 \omega^2(t')}_{v_{cm}^2(t')} + \frac{1}{2} m v_{cm}^2 = \frac{3}{4} m v_{cm}^2(t') = 6\,J$$

TRASL

$\bar{x}(t)$ $\bar{v}(t)$ $\bar{a}(t)$ m; $\bar{F}(t)$ $\bar{P} = m\bar{v}$

$\sum \bar{F} = m\bar{a}$ $\bar{F} = \frac{d\bar{p}}{dt}$

ROT

$\vartheta(t)$ $\bar{\omega}(t)$ $\bar{\alpha}(t)$ I $\bar{\tau}(t)$ $\bar{L} = I\bar{\omega}$

$\sum \bar{\tau} = I\bar{\alpha}$ $\bar{\tau} = \frac{d\bar{L}}{dt}$

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

$\bar{\tau} = \bar{r} \times \bar{F}$

Giroscopio

oggetto a simmetria cilindrica

$I_z \neq I_x = I_y$ rotazione su z

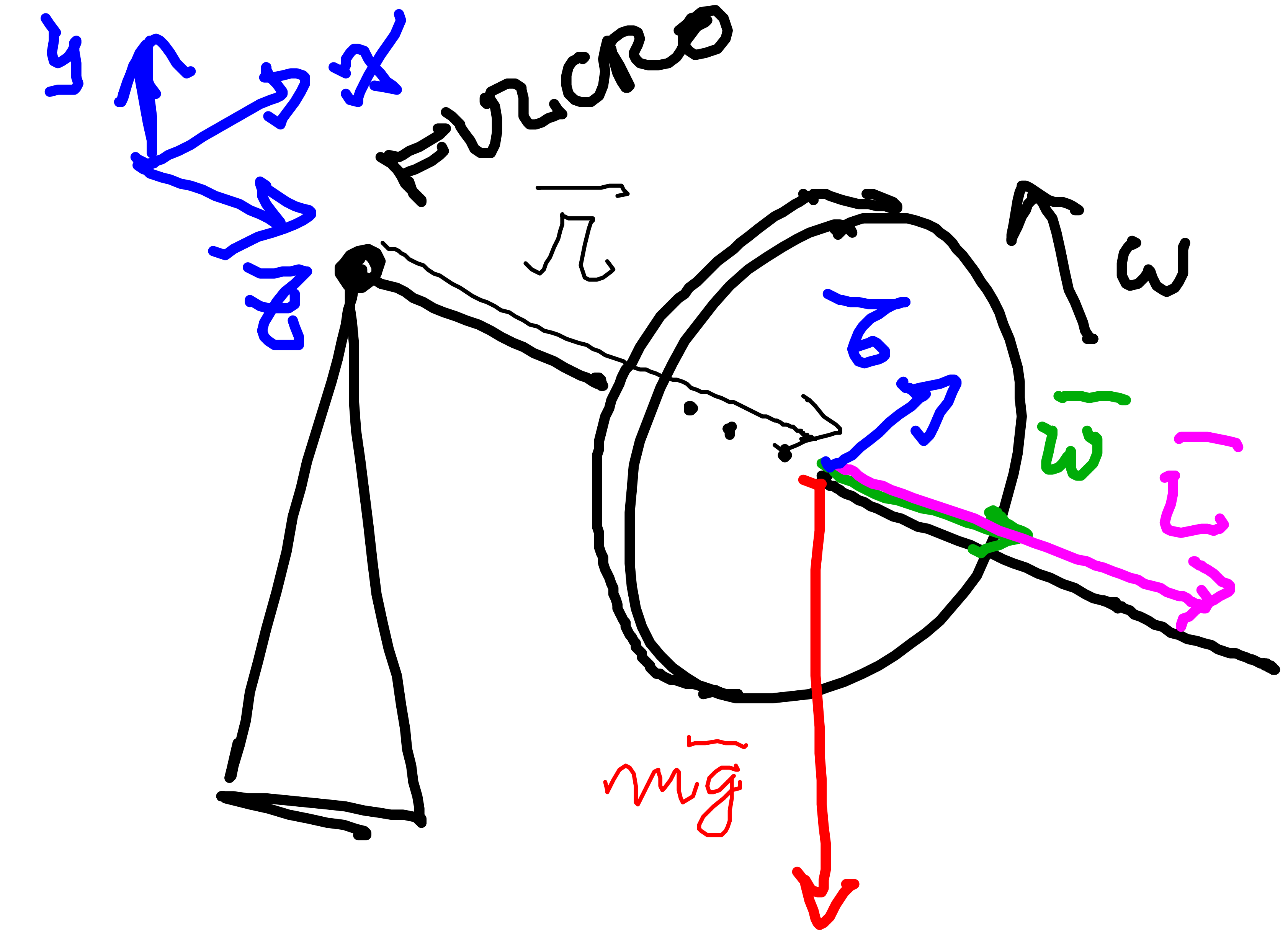
se penso alle sole forze, l'oggetto dovrebbe cadere

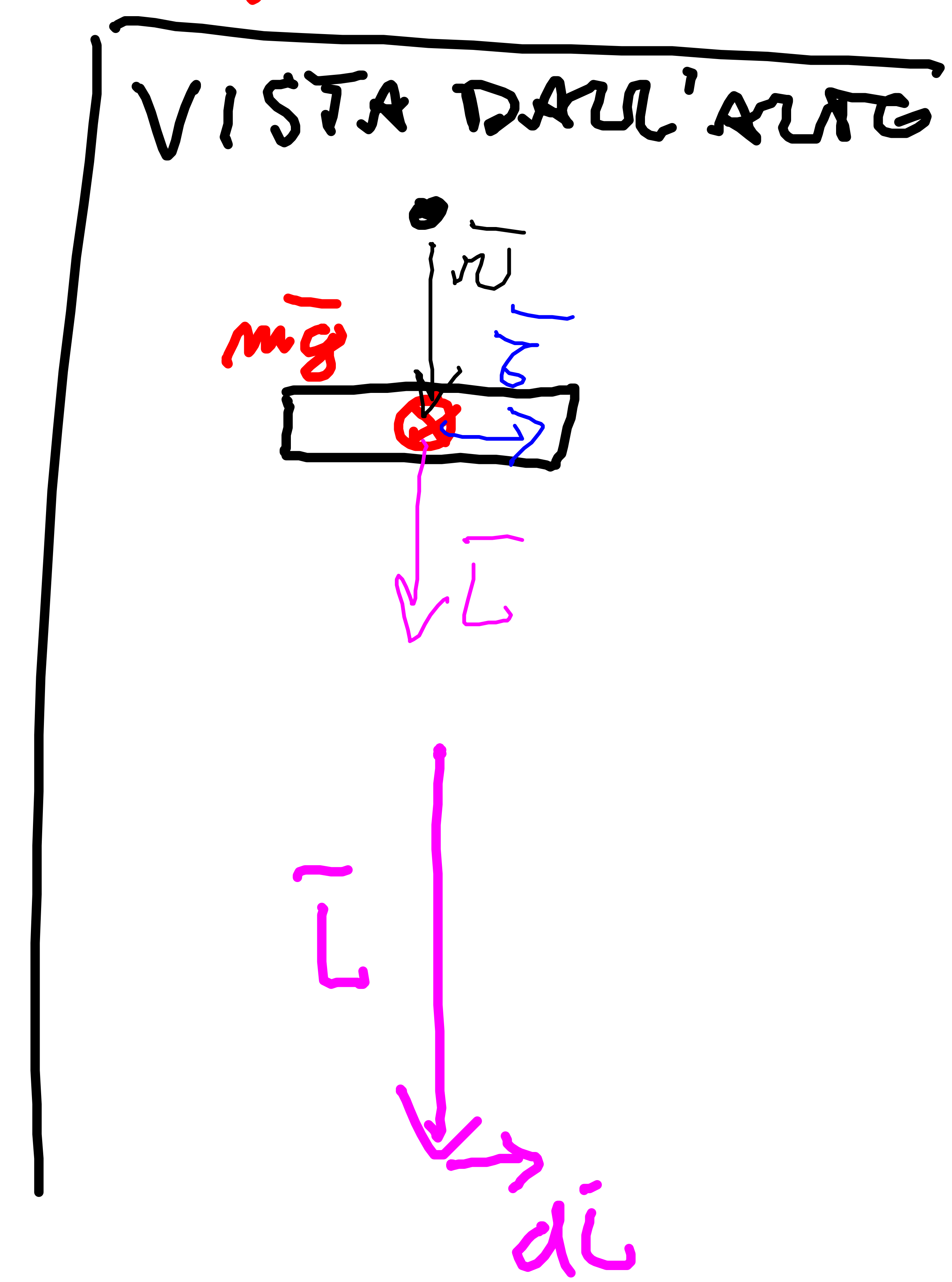
se cadesse si creerebbe un $\bar{\tau} = \bar{r} \times (m\bar{g})$

se ho già un $\bar{L}$ preesistente $\bar{\tau} = \frac{d\bar{L}}{dt}$

in un lasso di tempo dt $d\bar{L} = \bar{\tau}\, dt$ è PERPENDICOLARE ad $\bar{L}$

$\Rightarrow |\bar{L}|$ non cambia $\Rightarrow$ CONSERVAZIONE MOMENTO ANGOLARE

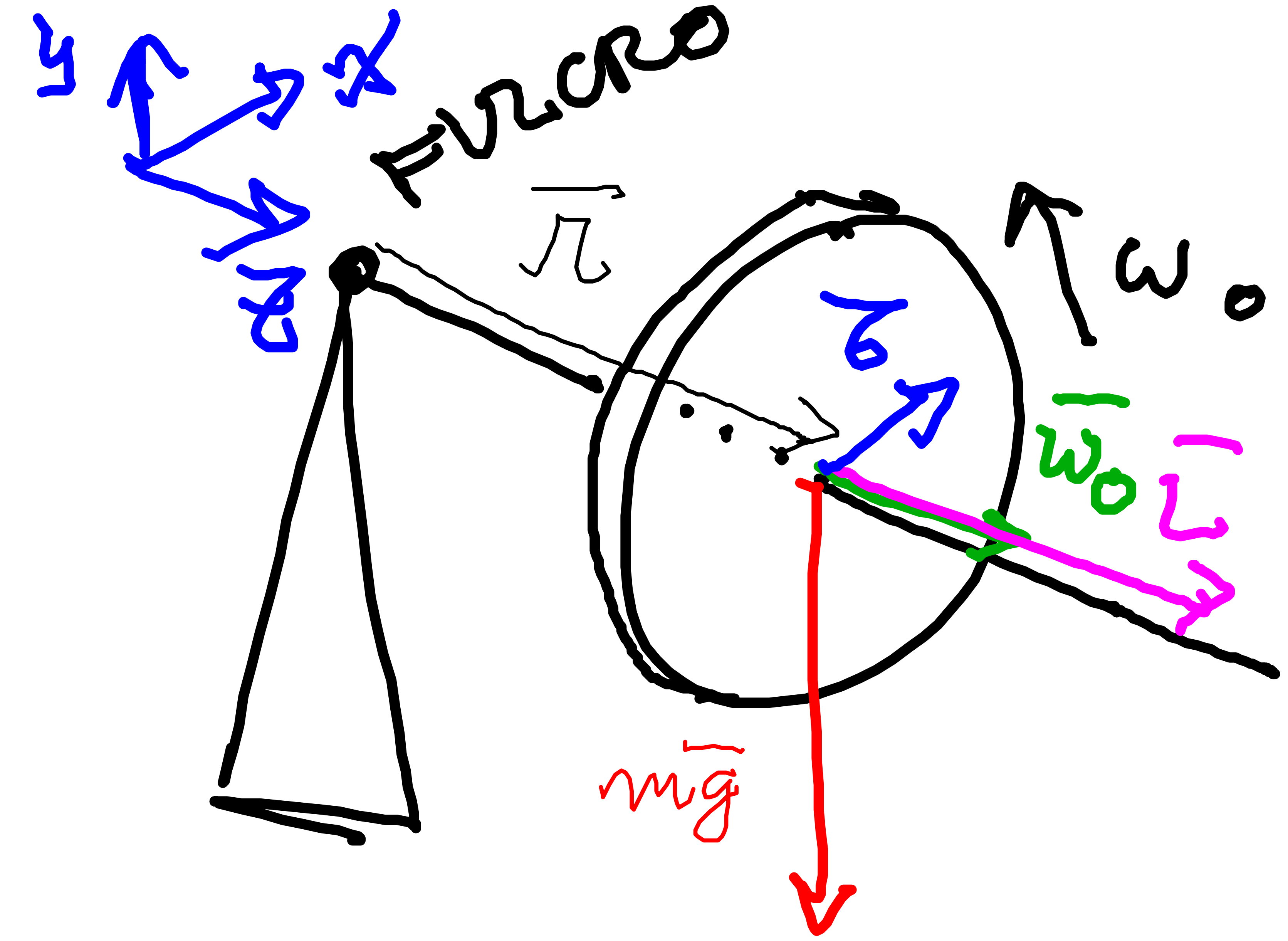


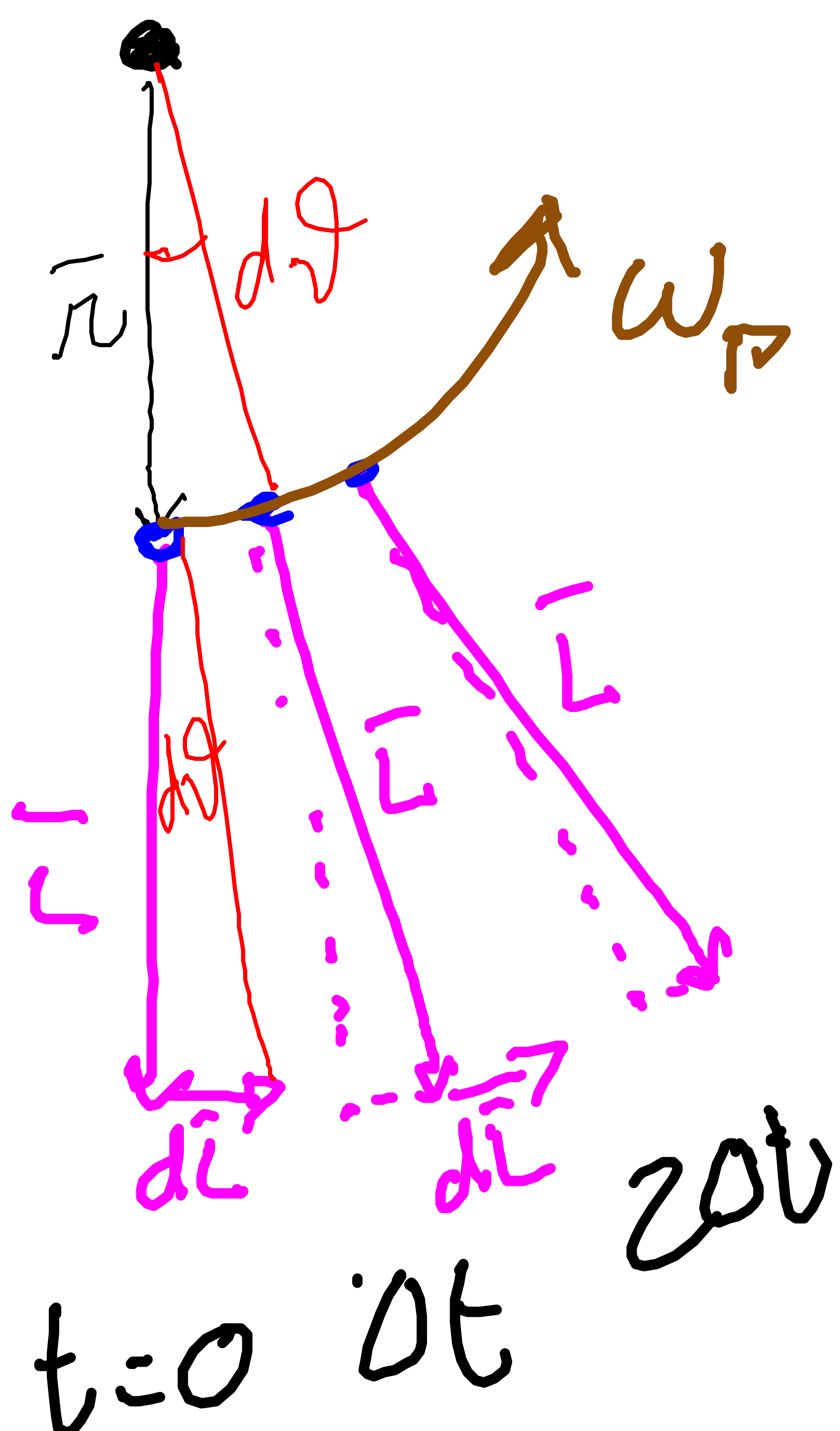


Giroscopio

oggetto a simmetria cilindrica

$I_z \neq I_x = I_y$ <u>rotazione su z</u>





MOTO DI PRECESSIONE

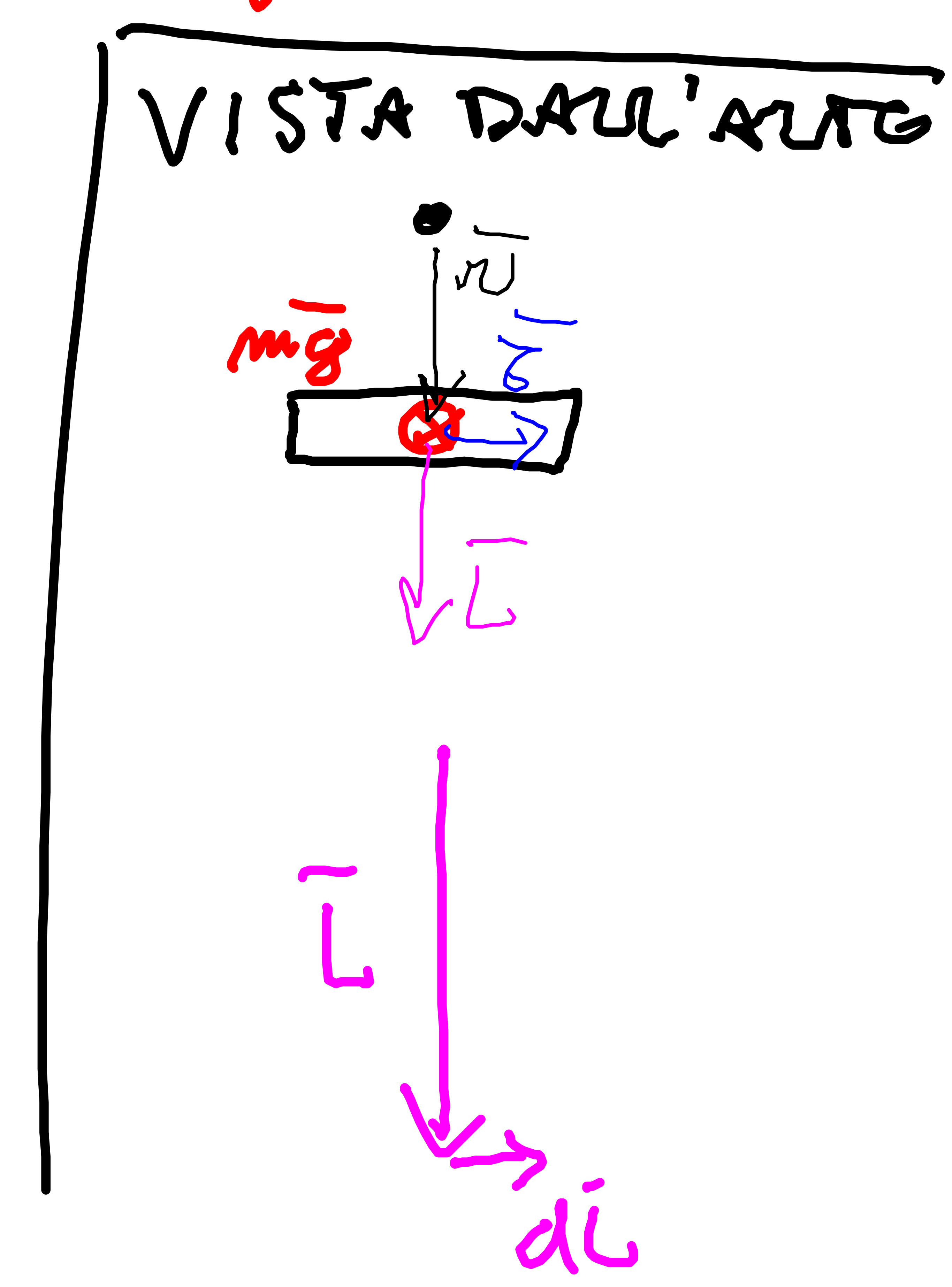
$$dL = L\,d\vartheta$$

$$\bar{\tau} = \frac{d\bar{L}}{dt}$$

$$dL = \tau\,dt = rmg$$

$$rmg\,dt = L\,d\vartheta$$

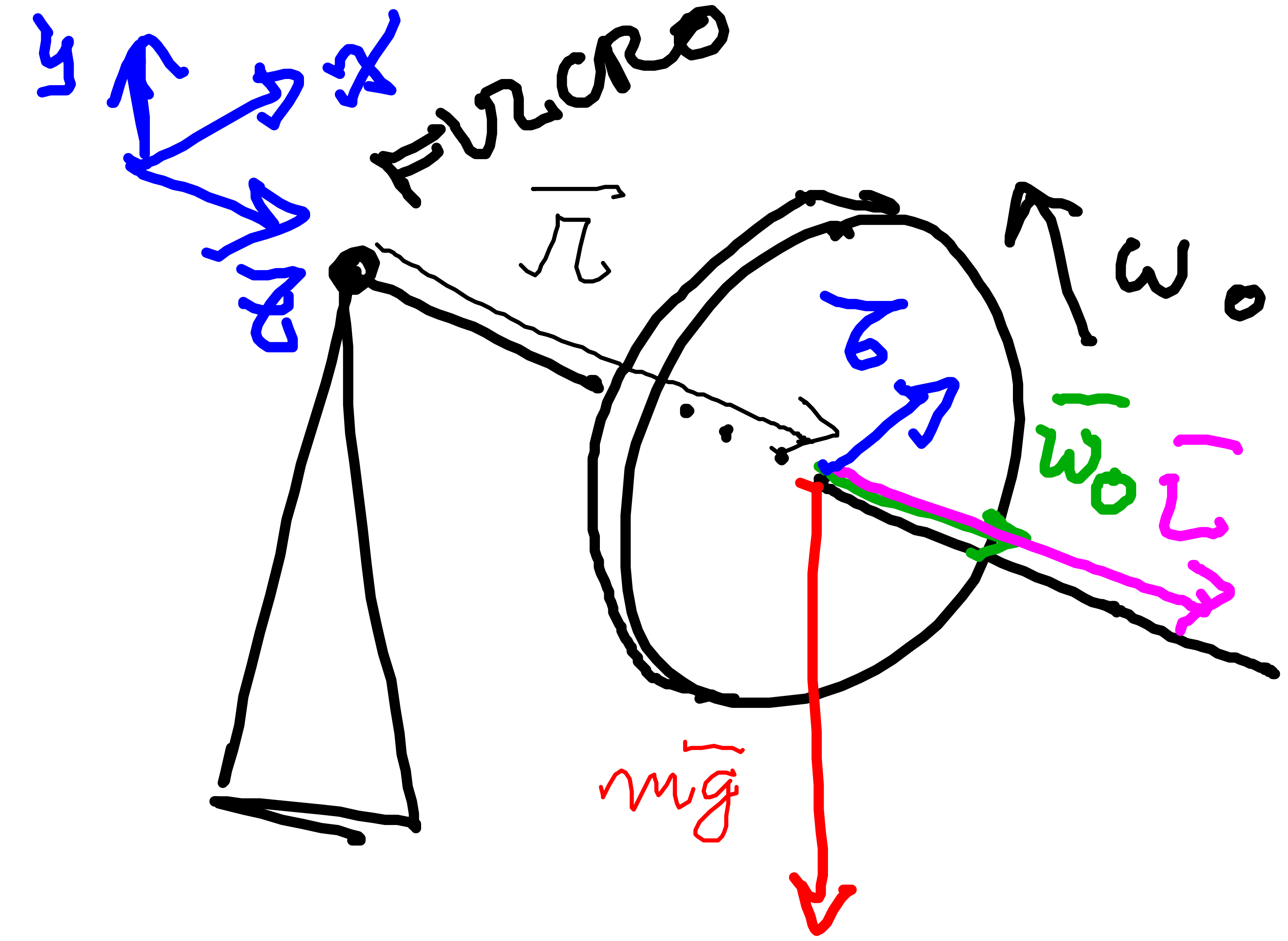
$$\omega_p = \frac{d\vartheta}{dt} = \frac{rmg}{I\omega_0} = \text{cost}$$

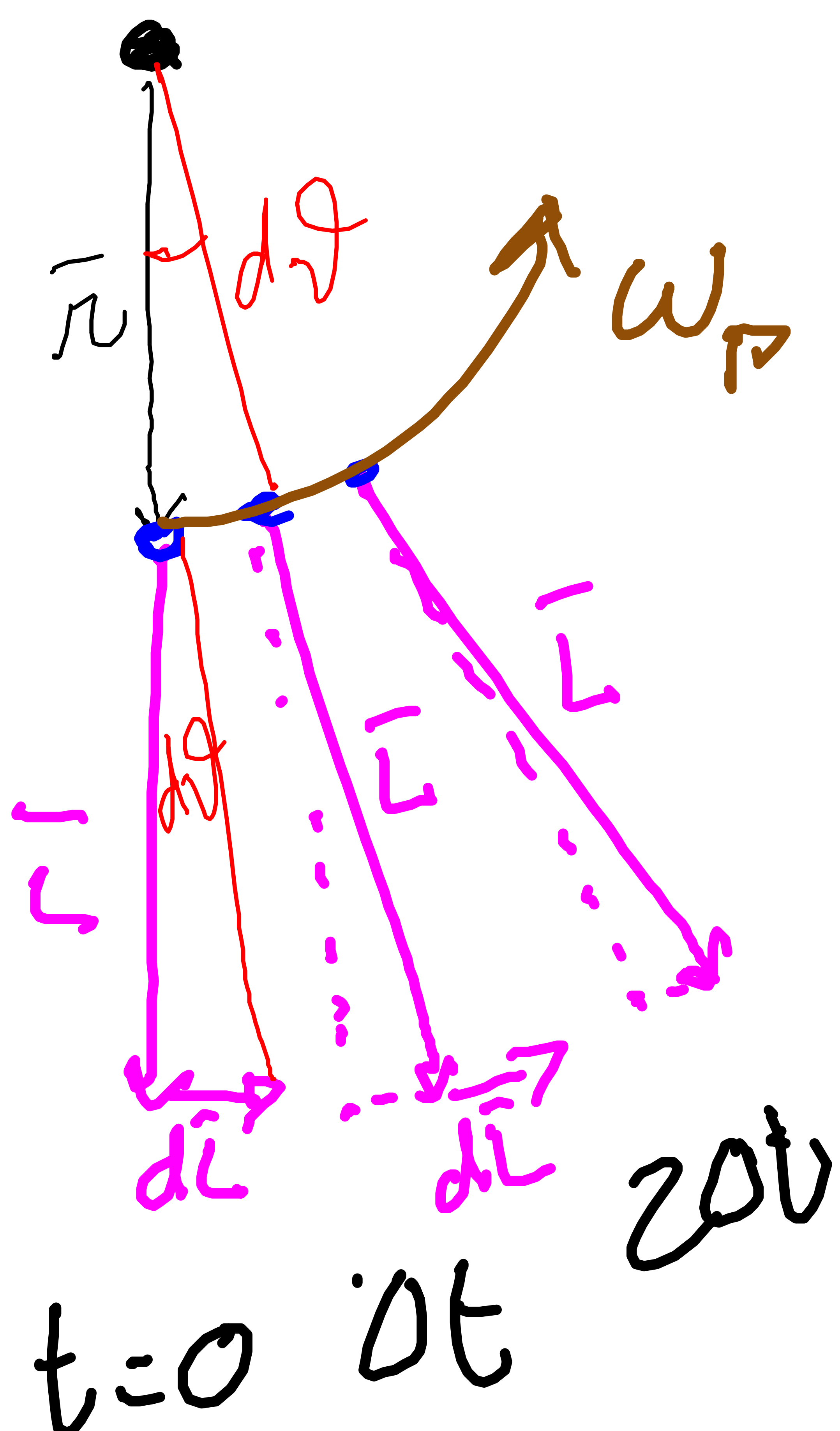


Giroscopio

oggetto a simmetria cilindrica

$I_z \neq I_x = I_y$ rotazione su z





MOTO DI PRECESSIONE

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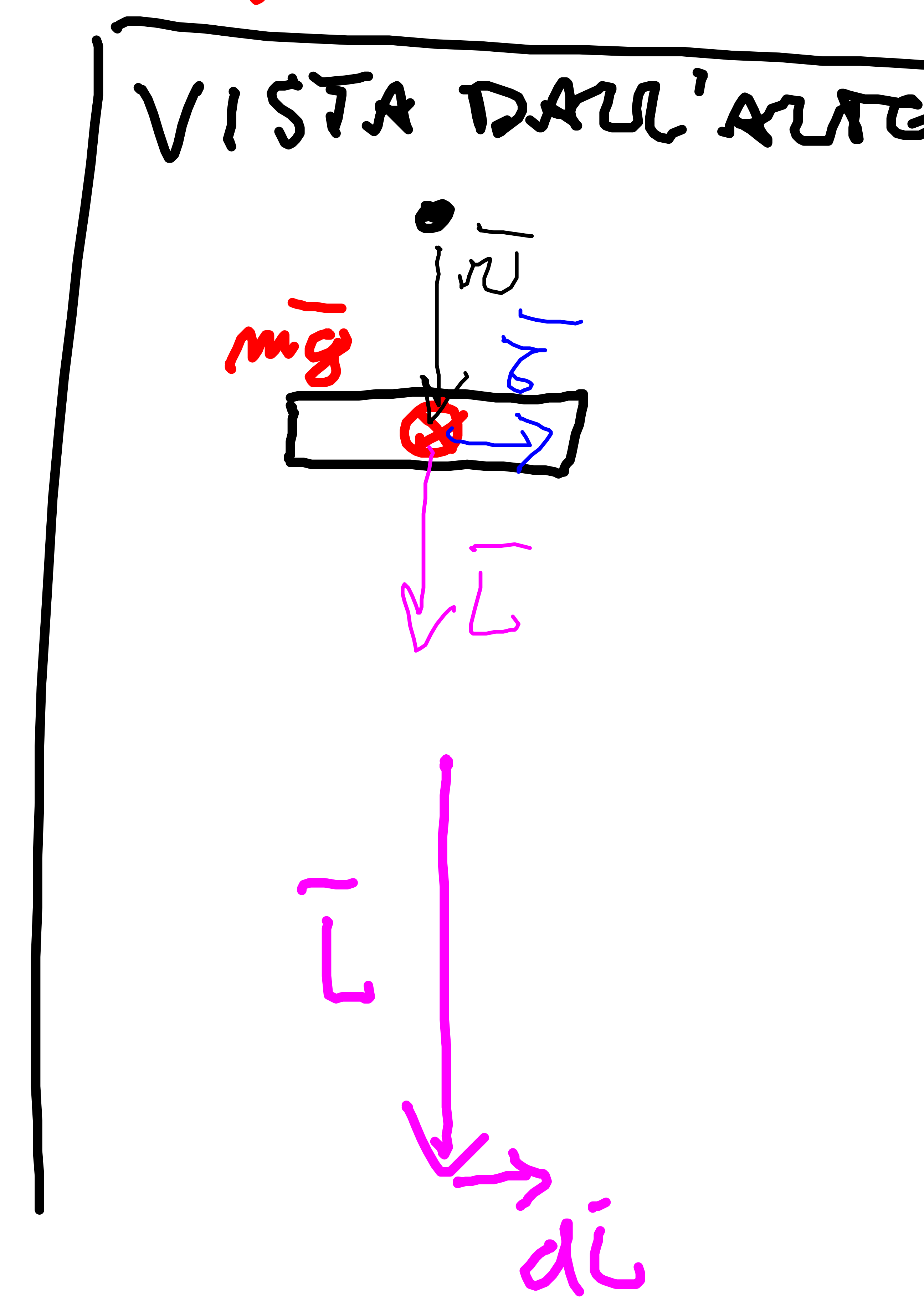
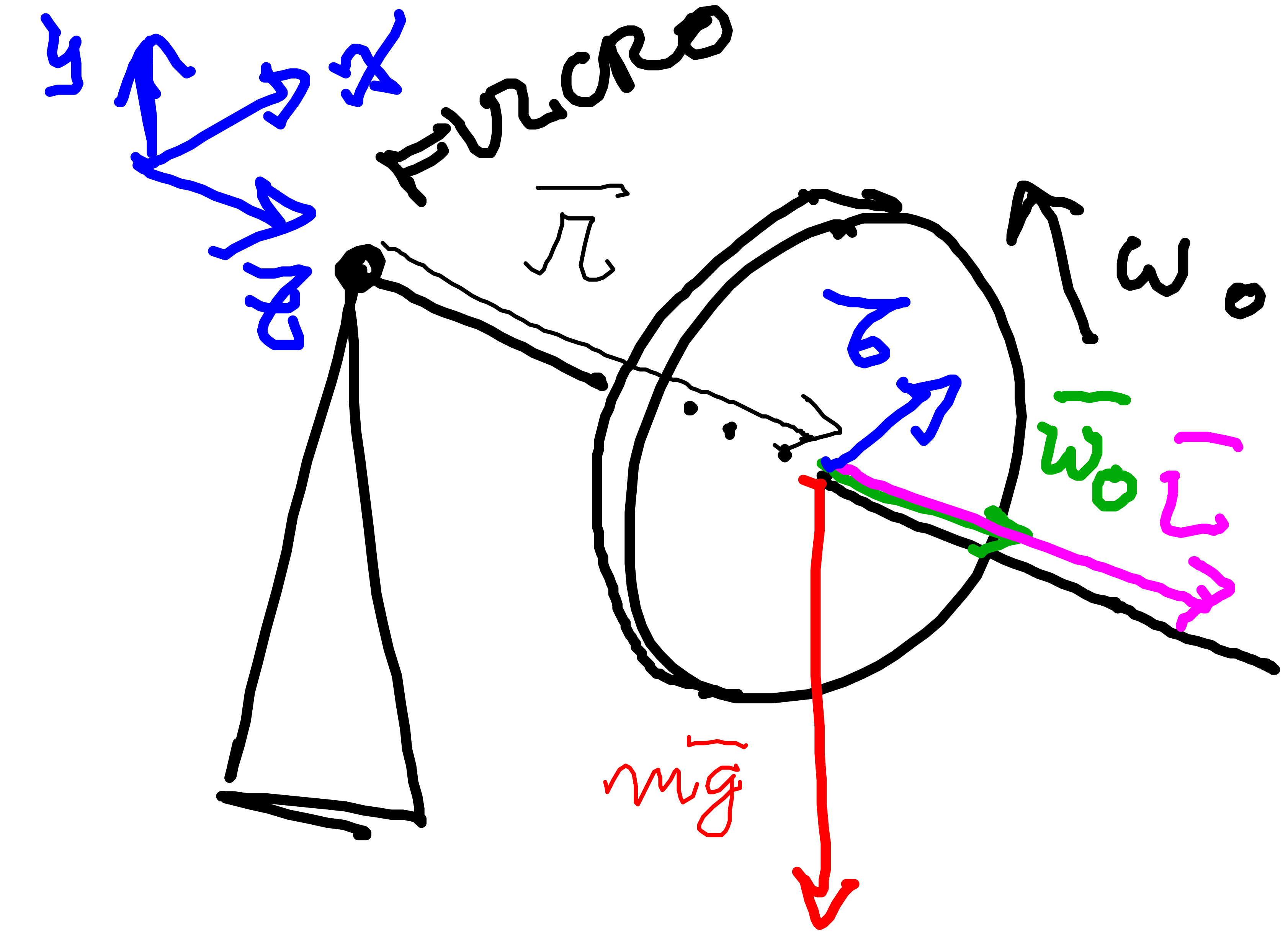


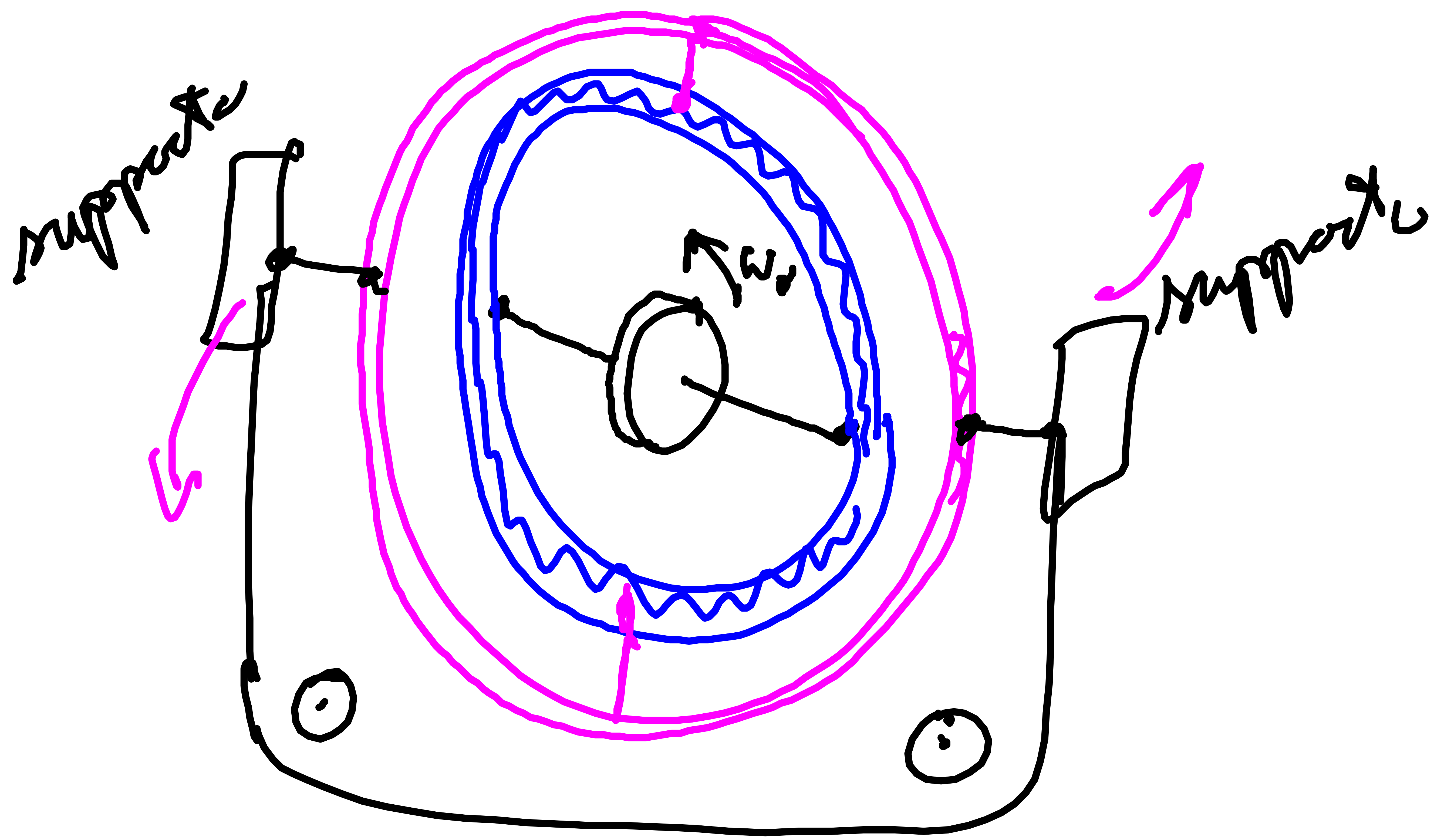
Giroscopio

oggetto a simmetria cilindrica

$I_z \neq I_x = I_y$ rotazione su z



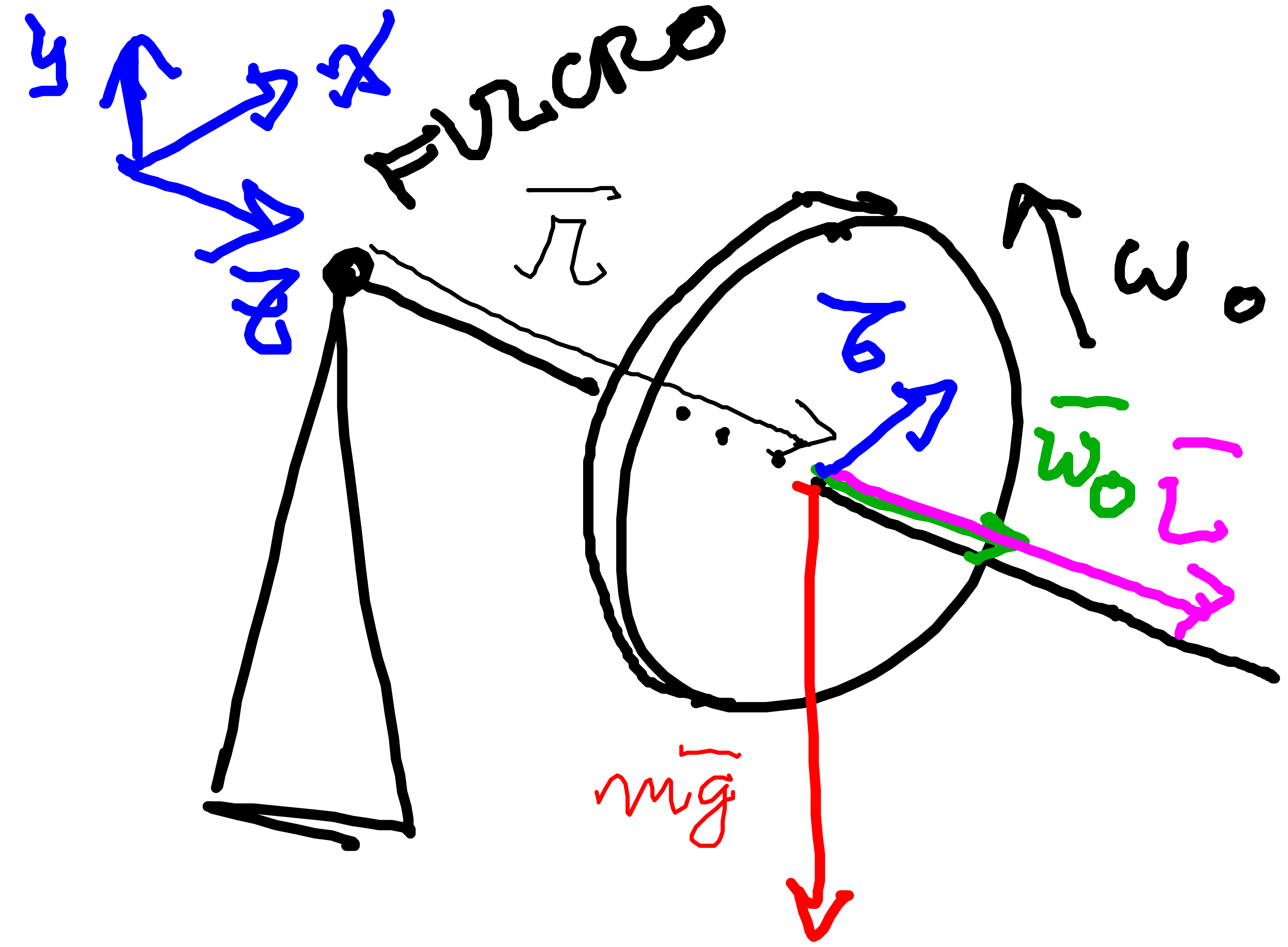
SOSPENSIONE CARDANICA 2D



Giroscopio

oggetto a simmetria cilindrica

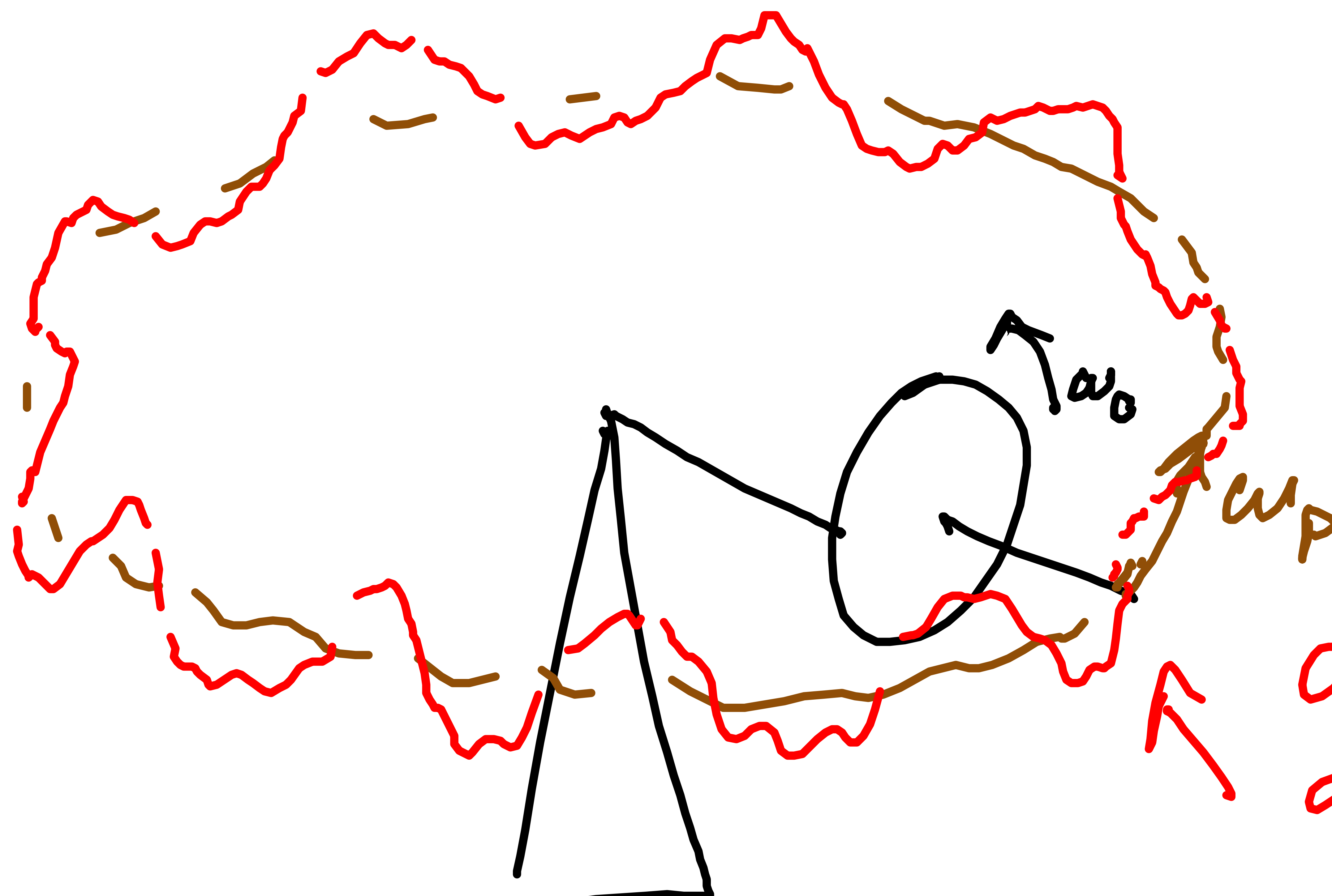
$I_z \neq I_x = I_y$ rotazione su z



ω_p su piano xz

$\overline{\omega_p} \parallel \hat{j}$

NUTAZIONE



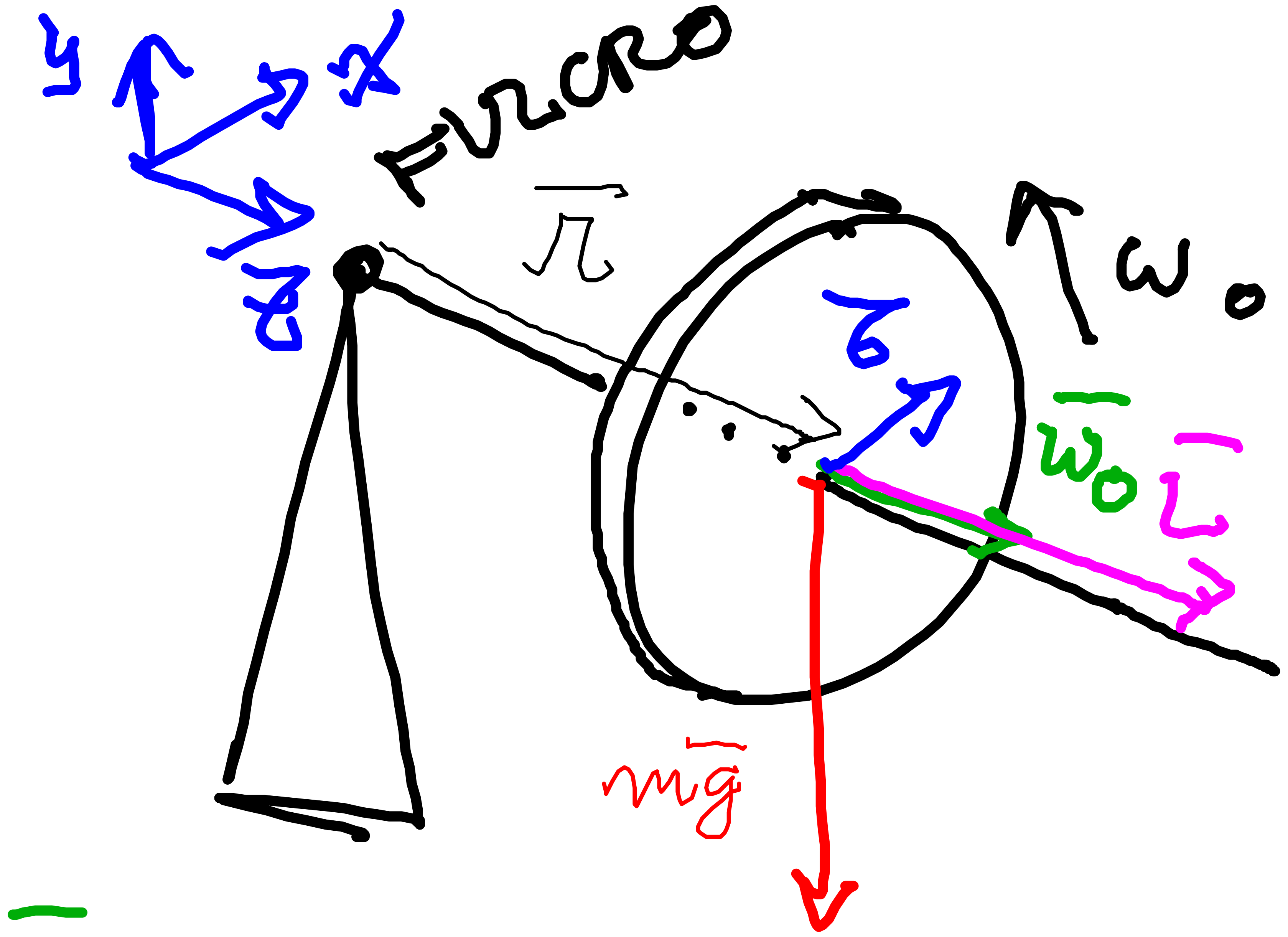
oscillazione attorno a traiettoria ω_p

NUTAZIONE

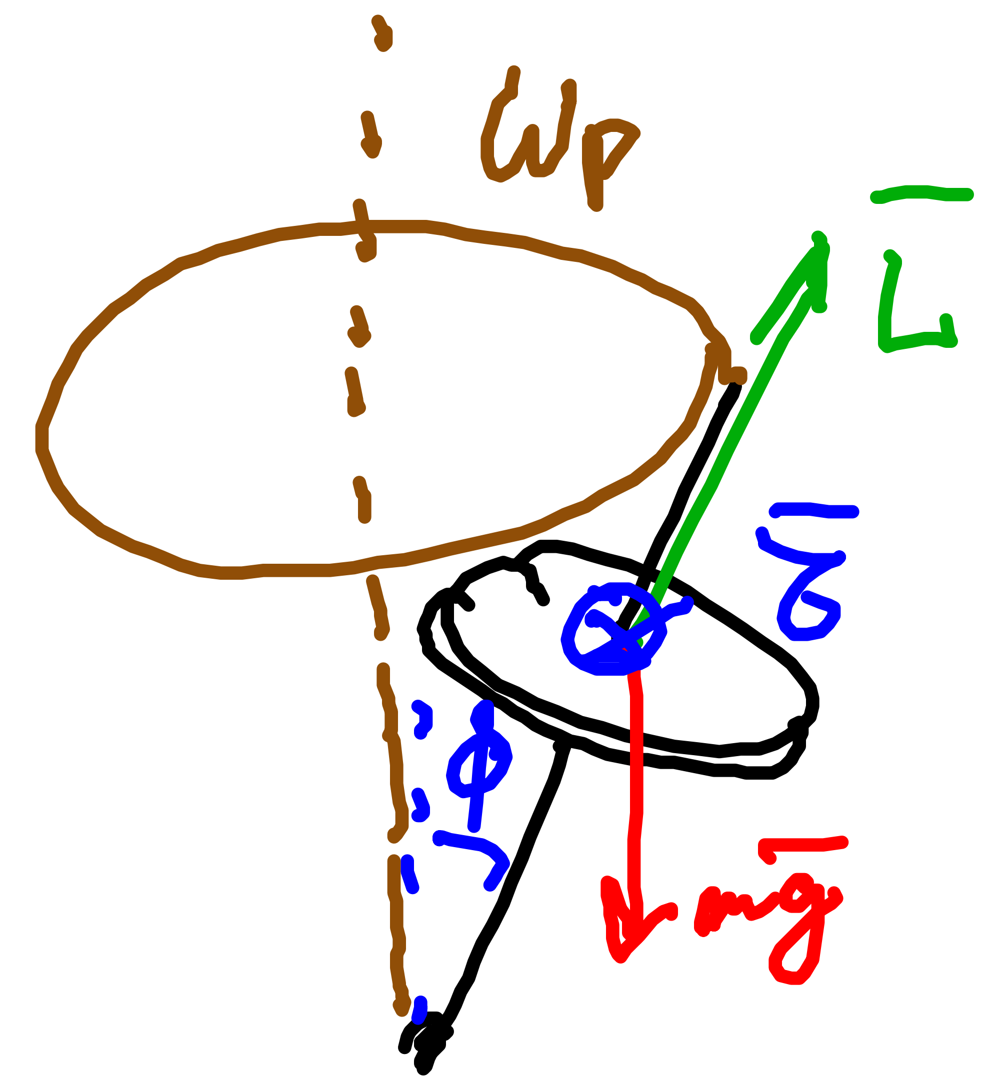
Giroscopio

oggetto a simmetria cilindrica

$I_z \neq I_x = I_y$ rotazione su z



TROTTOLA



$\omega_p = \frac{\tau}{I\omega_0}$

per attrito
ω diminuisce
→ ω_p aumenta
→ ϕ aumenta