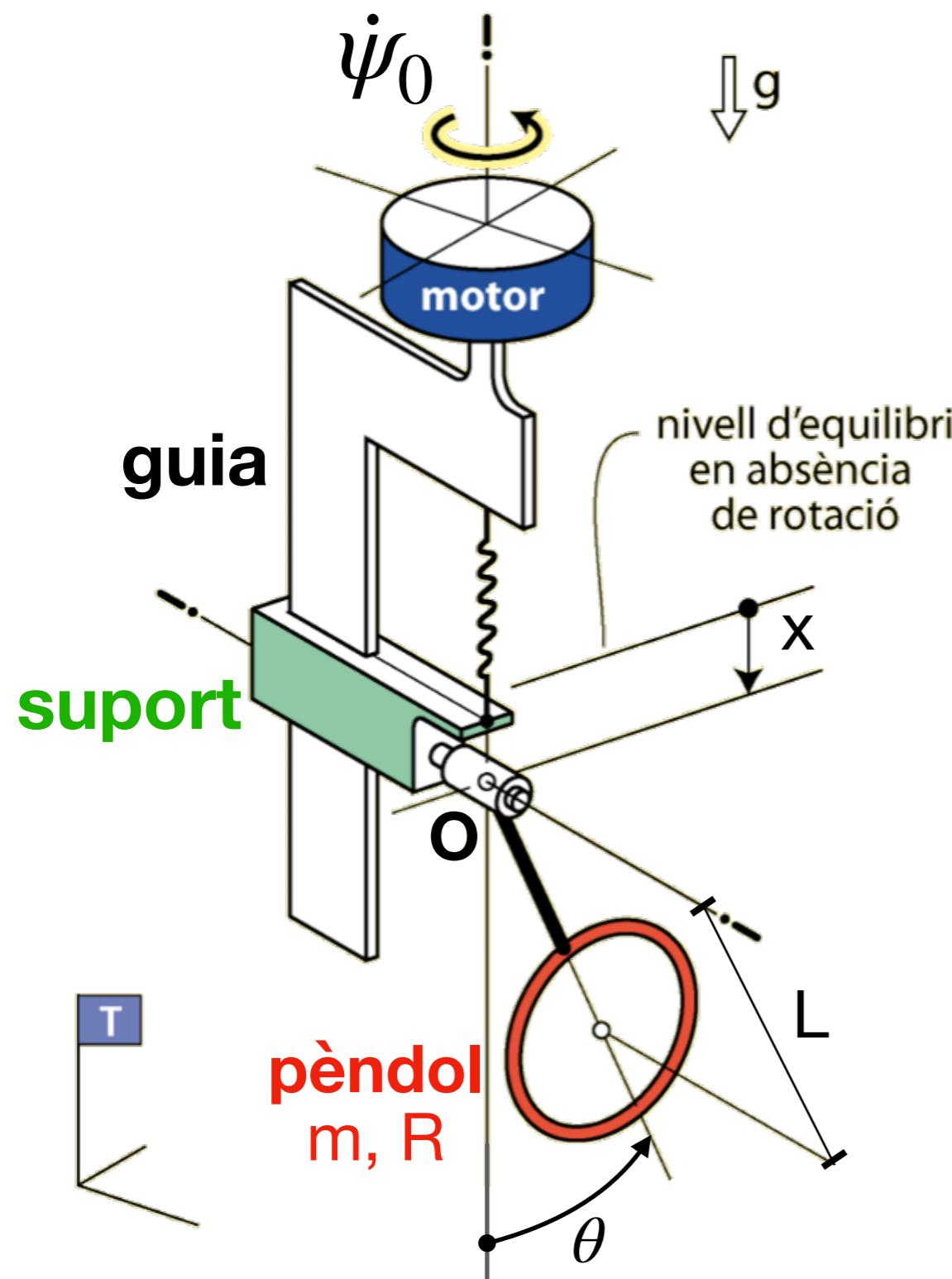


13P

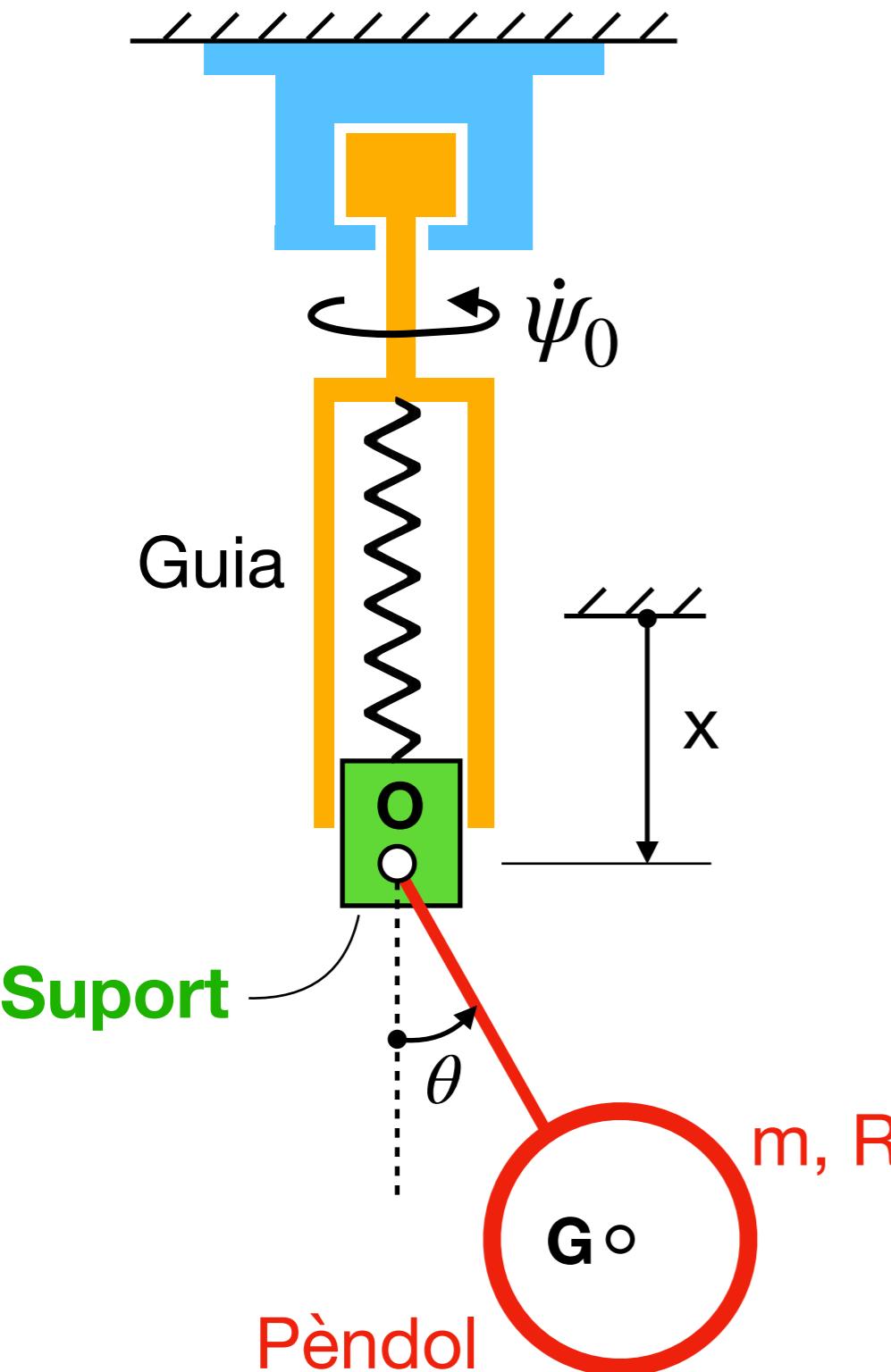
Teoremes vectorials III

Exemples 3D

- DGI
- Eqs. mov. per a x i θ
- Parell motor Γ per mantenir $\dot{\psi}_0 = \text{ct}$

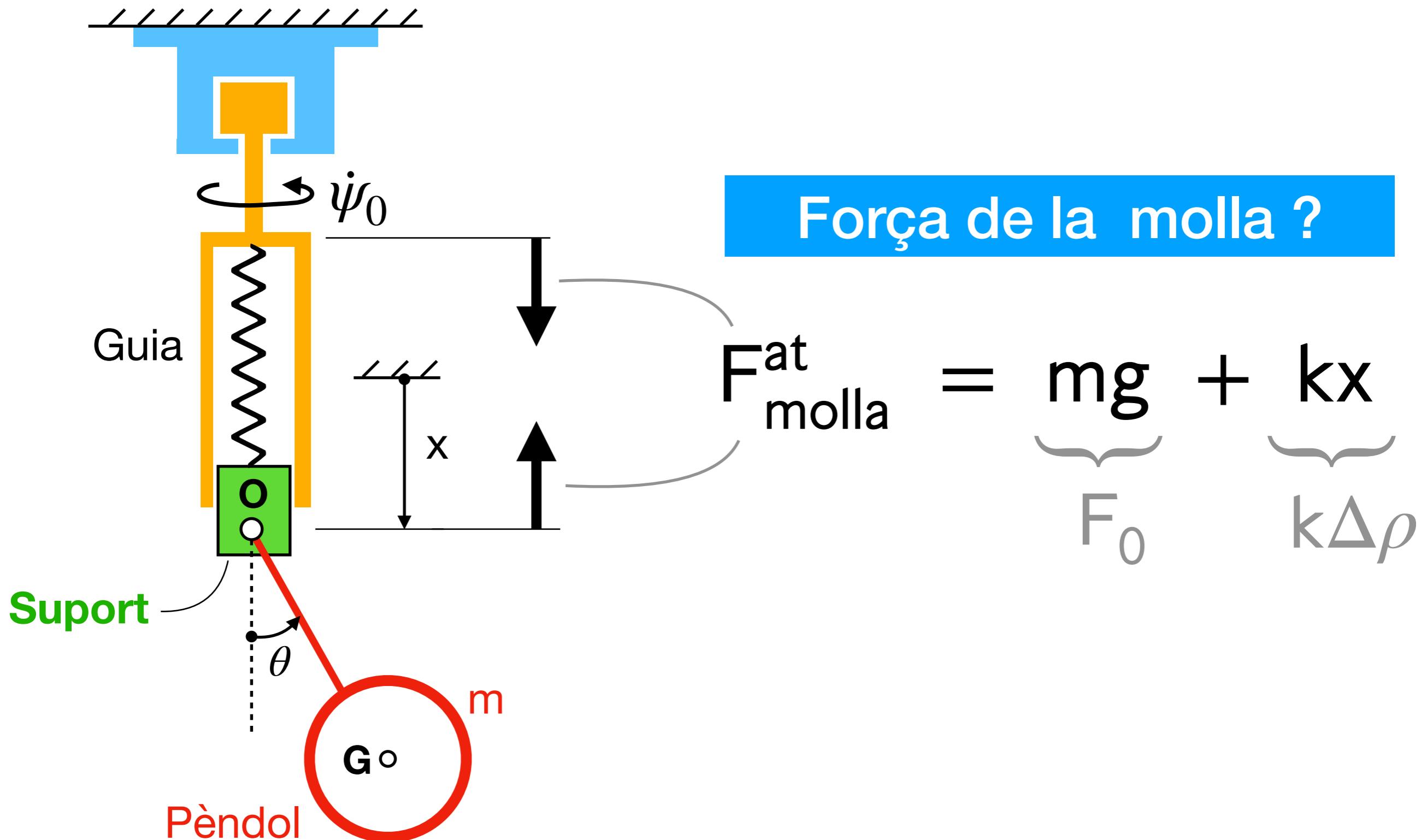


Amb motor aturat: $x = 0, \theta = 0$ és config. d'equilibri



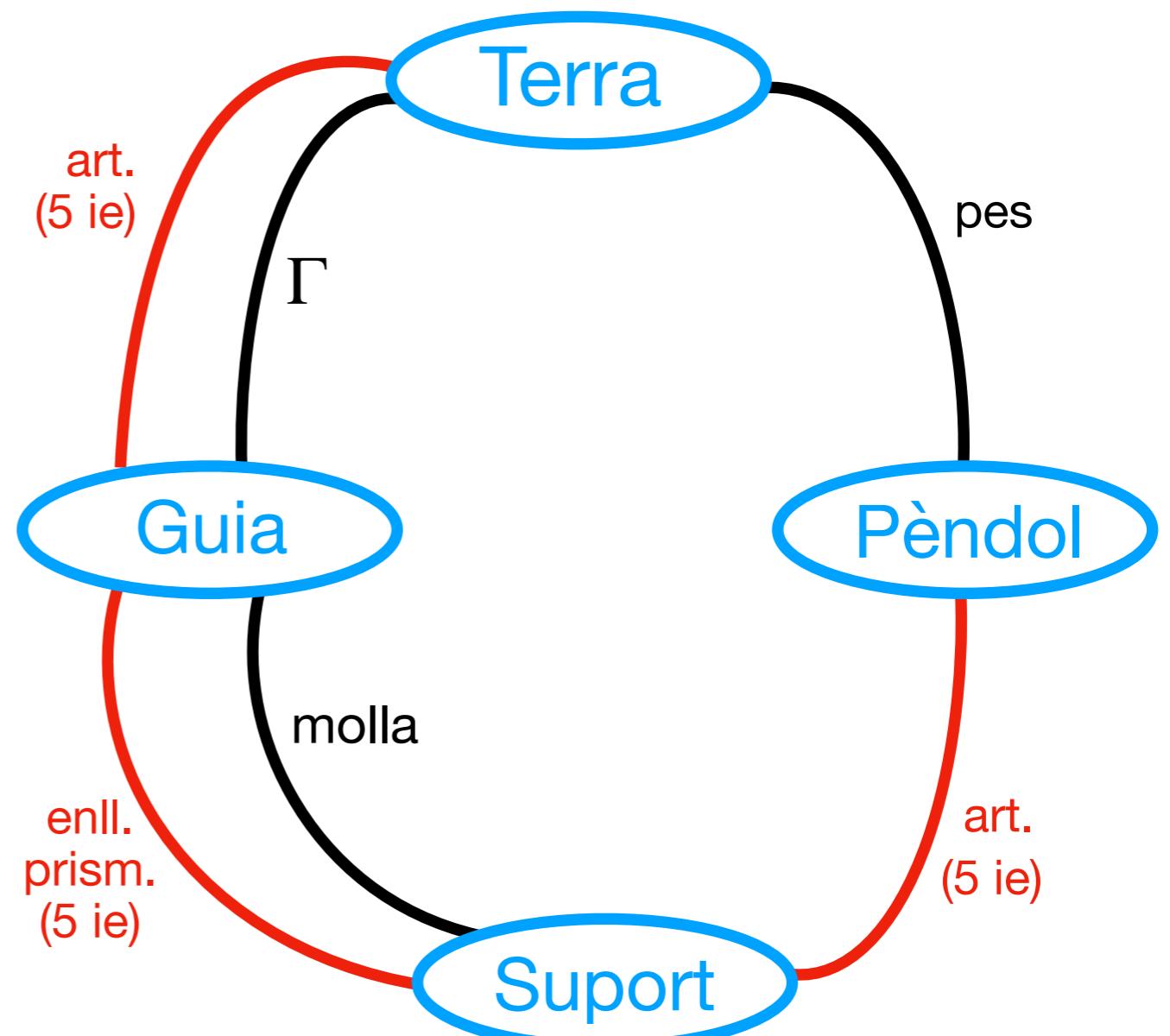
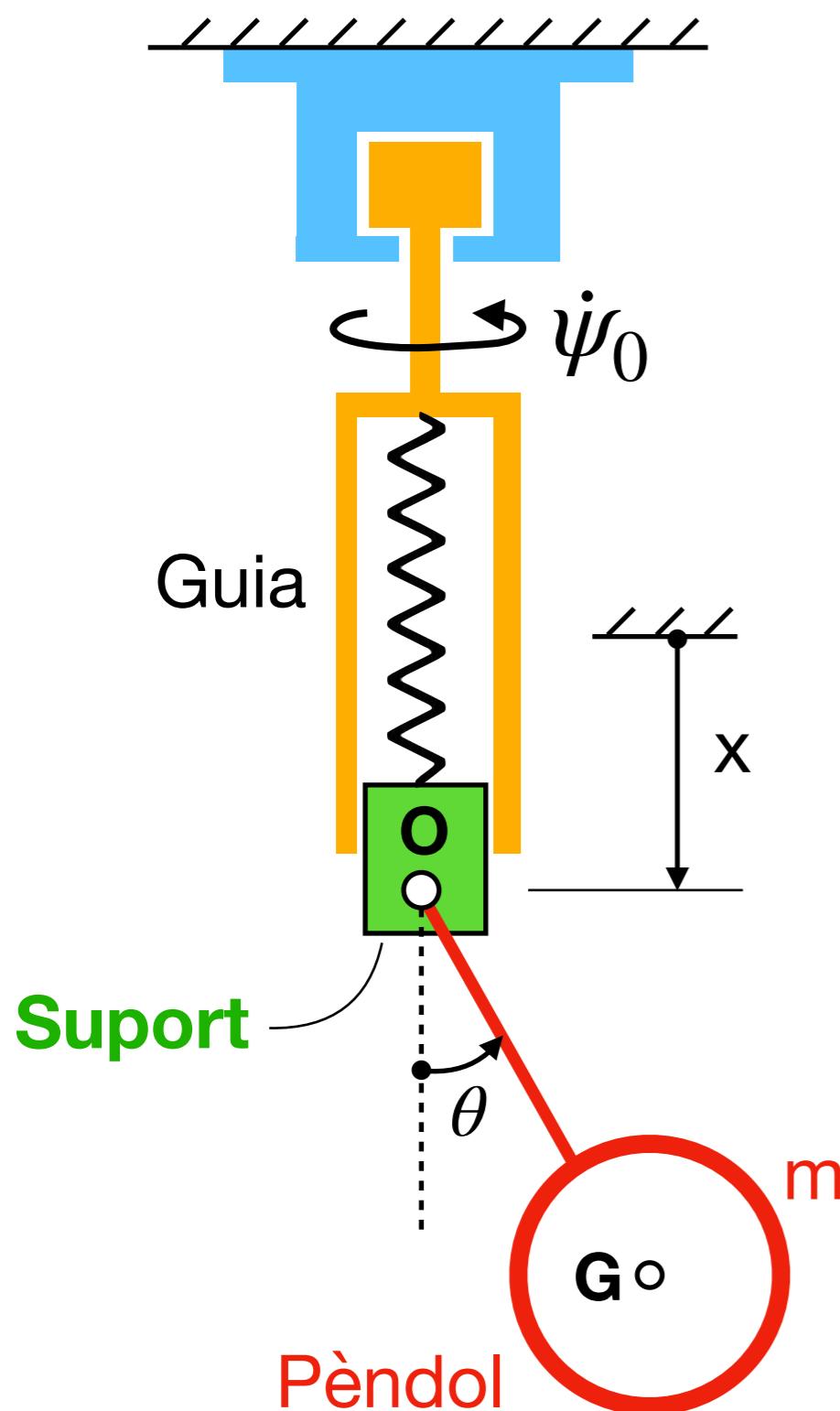
- DGI
- Eqs. mov. per a x i θ
- Parell motor Γ per mantenir $\dot{\psi}_0 = \text{ct}$

Amb motor aturat: $x = 0, \theta = 0$ és config. d'equilibri



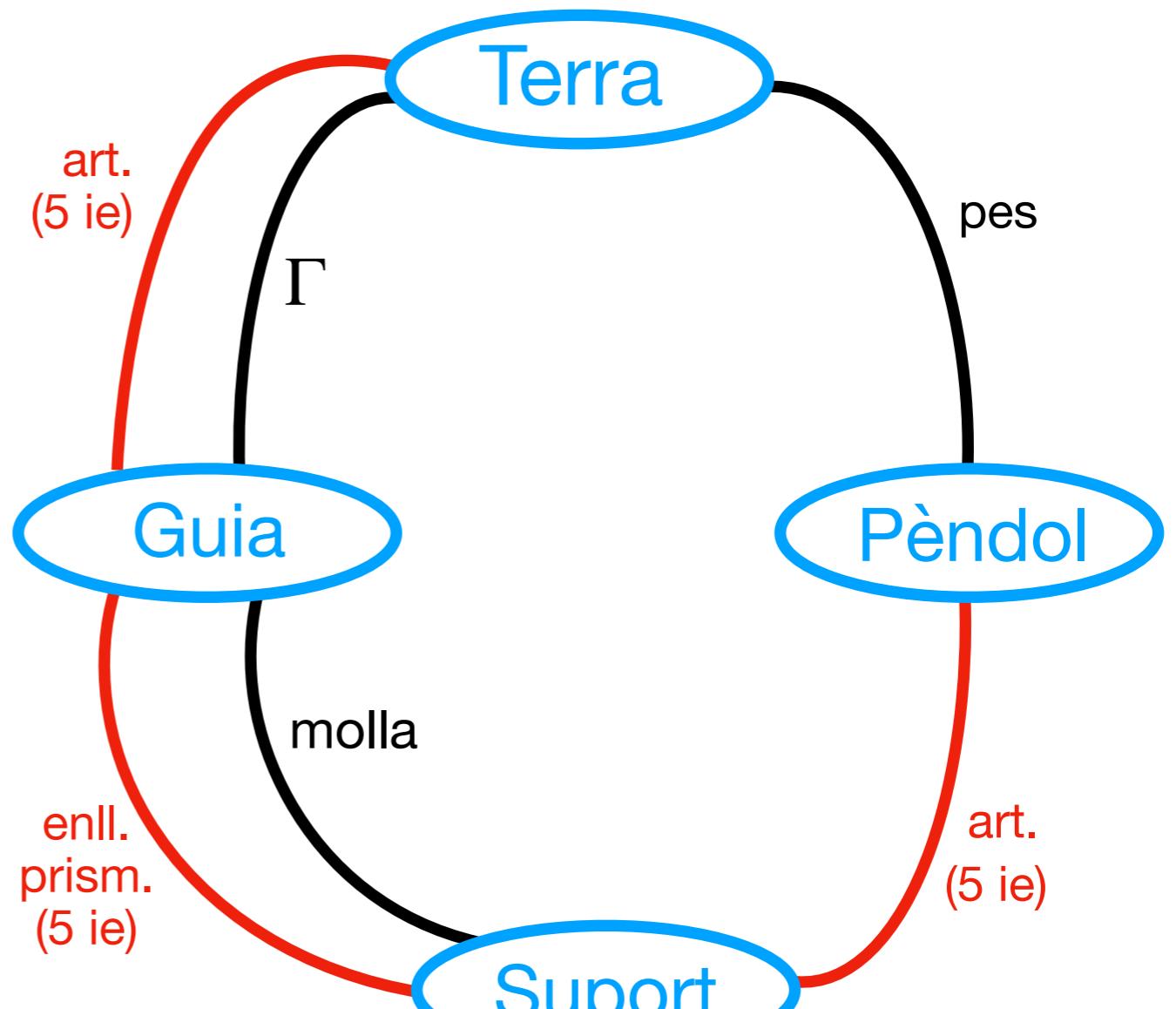
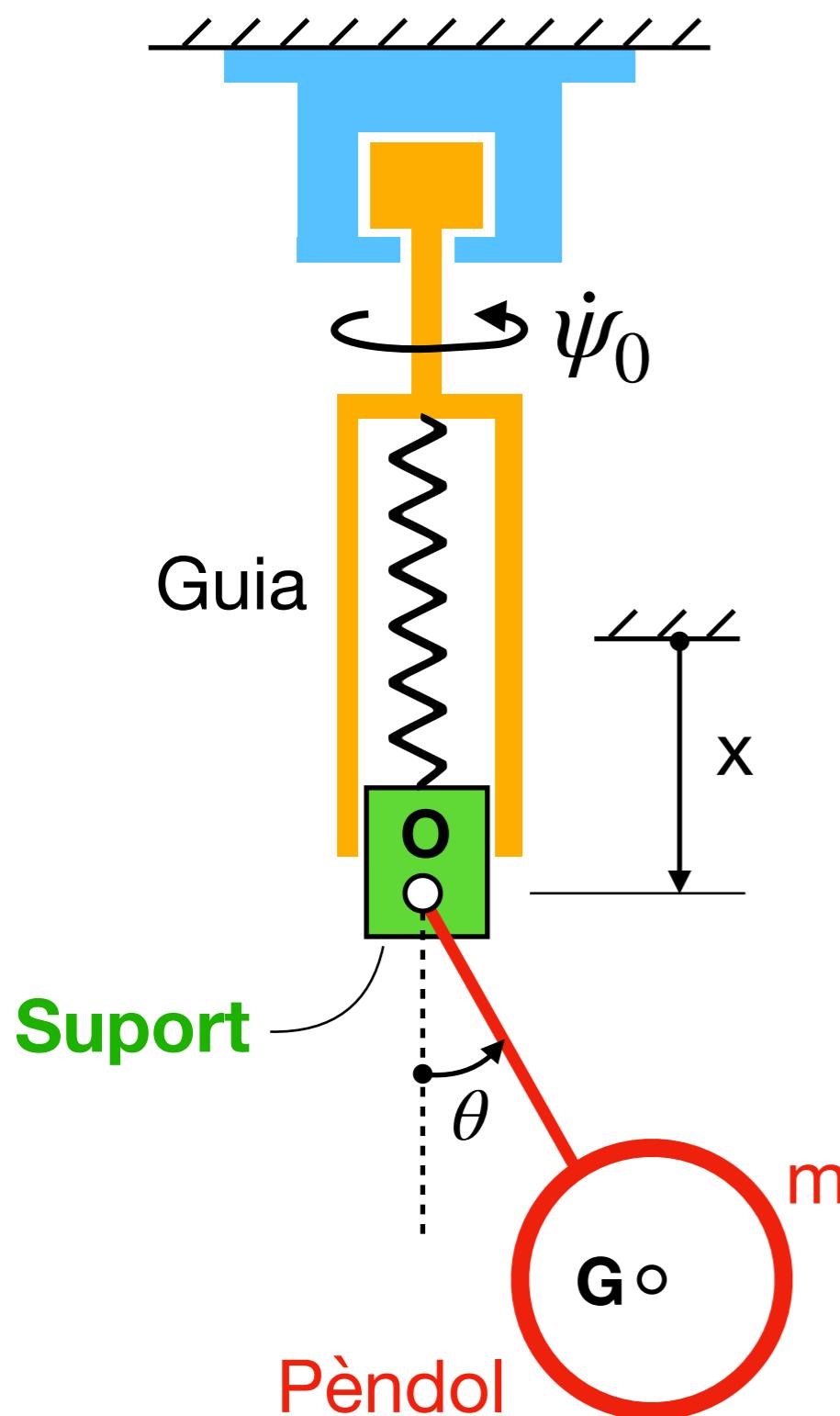
Amb motor aturat: $x = 0, \theta = 0$ és config. d'equilibri

DGI



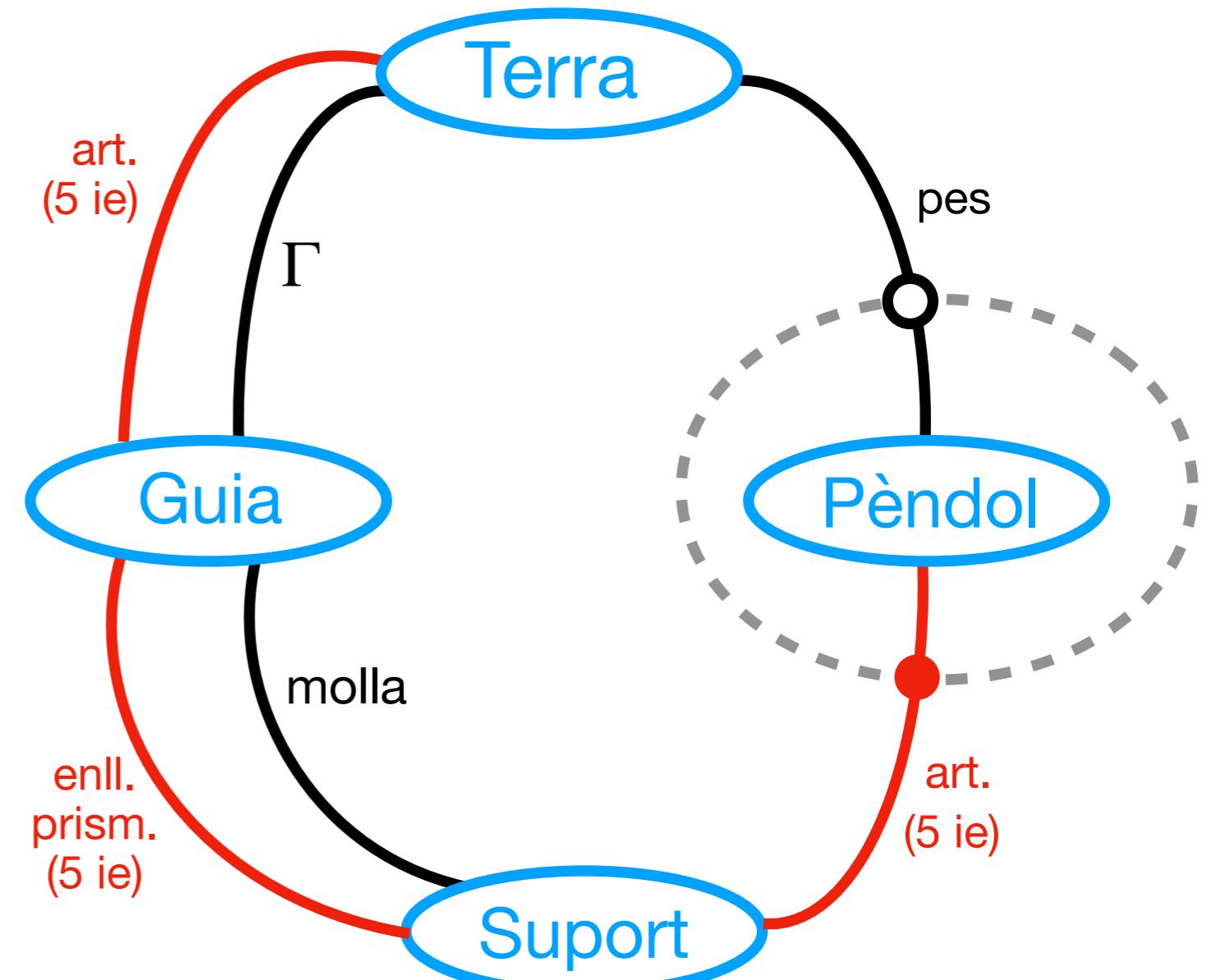
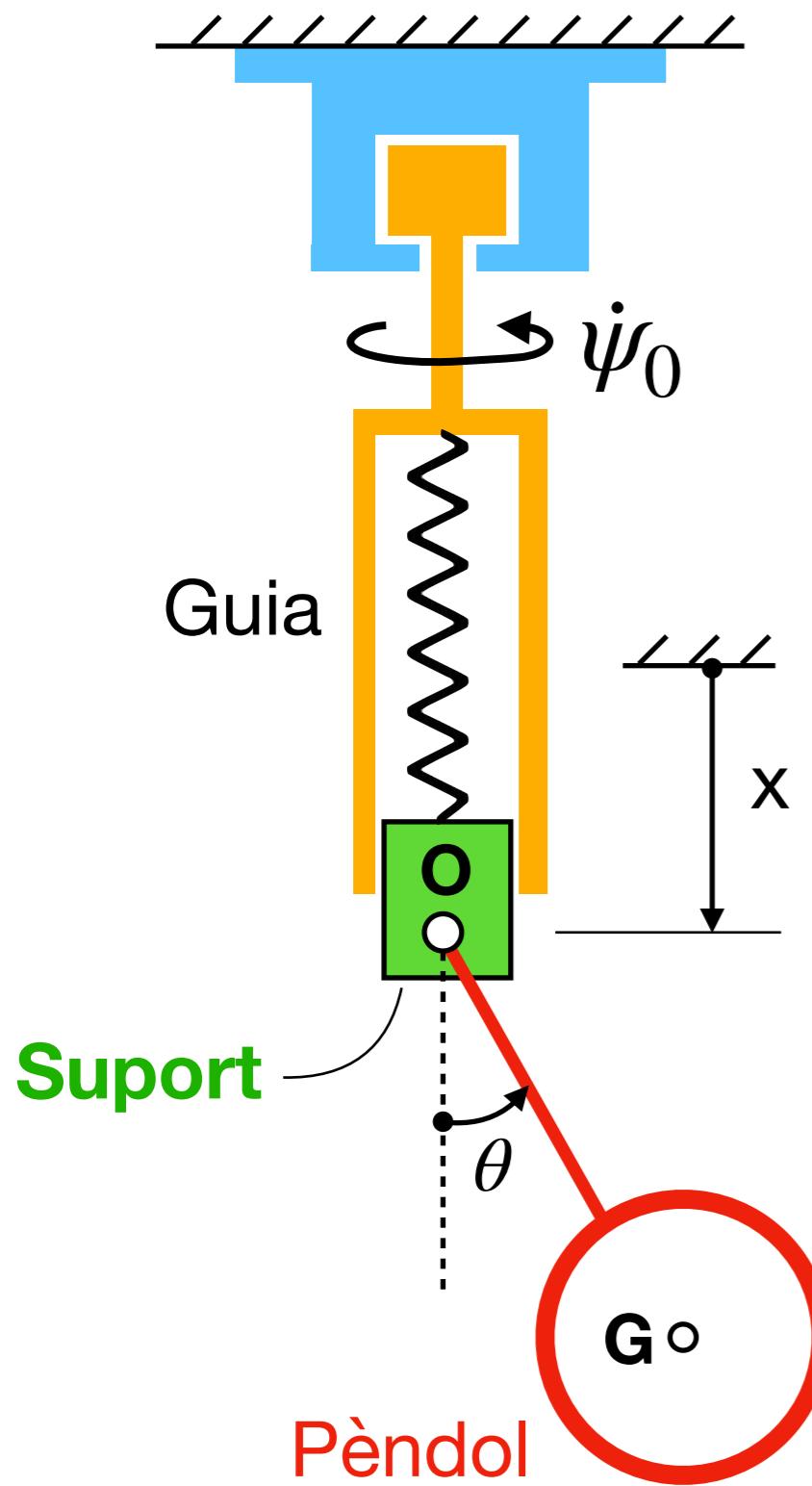
$15 \text{ ie}, \Gamma, \ddot{x}, \ddot{\theta} \Rightarrow 18 \text{ incòg}$ } **DET**
 $3 \text{ solids} \cdot 6 \text{ eqs/sòlid} \Rightarrow 18 \text{ eqs}$

DGI



x i θ només afecten **pèndol** i **suport**

Explorem sistemes que els incloguin



Sistema

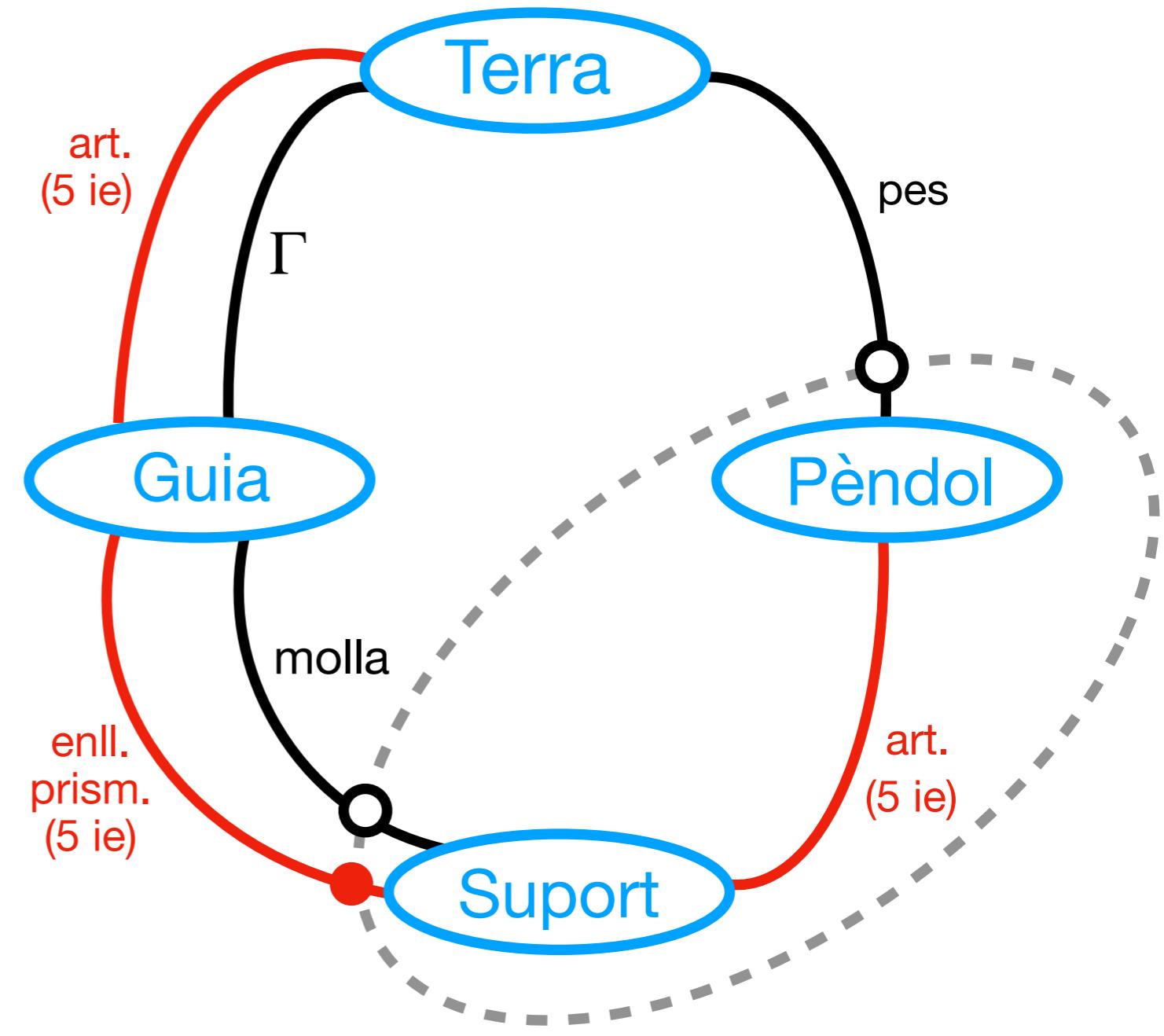
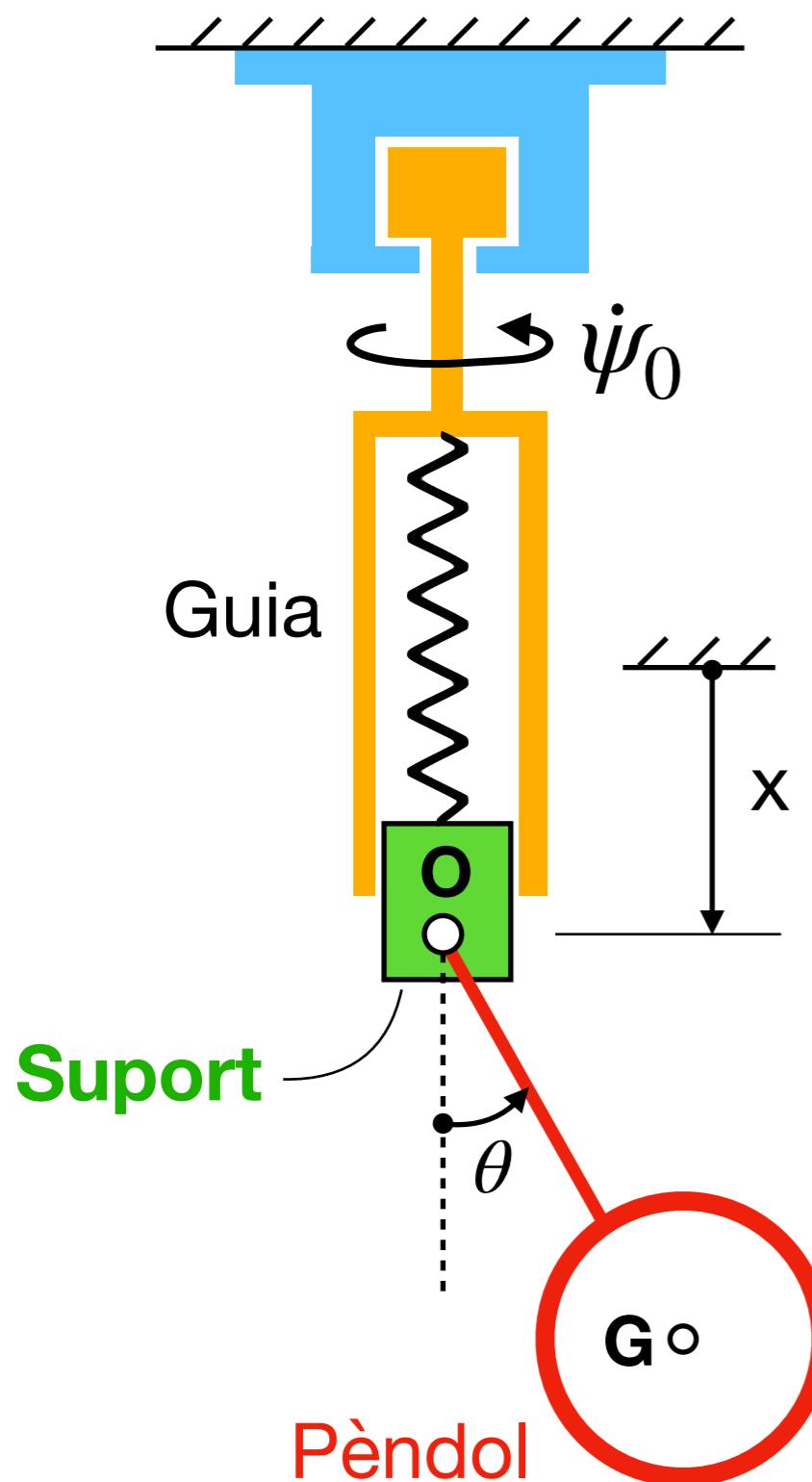
Pèndol

Incògn.

$5 \text{ ie}, \ddot{x}, \ddot{\theta}$

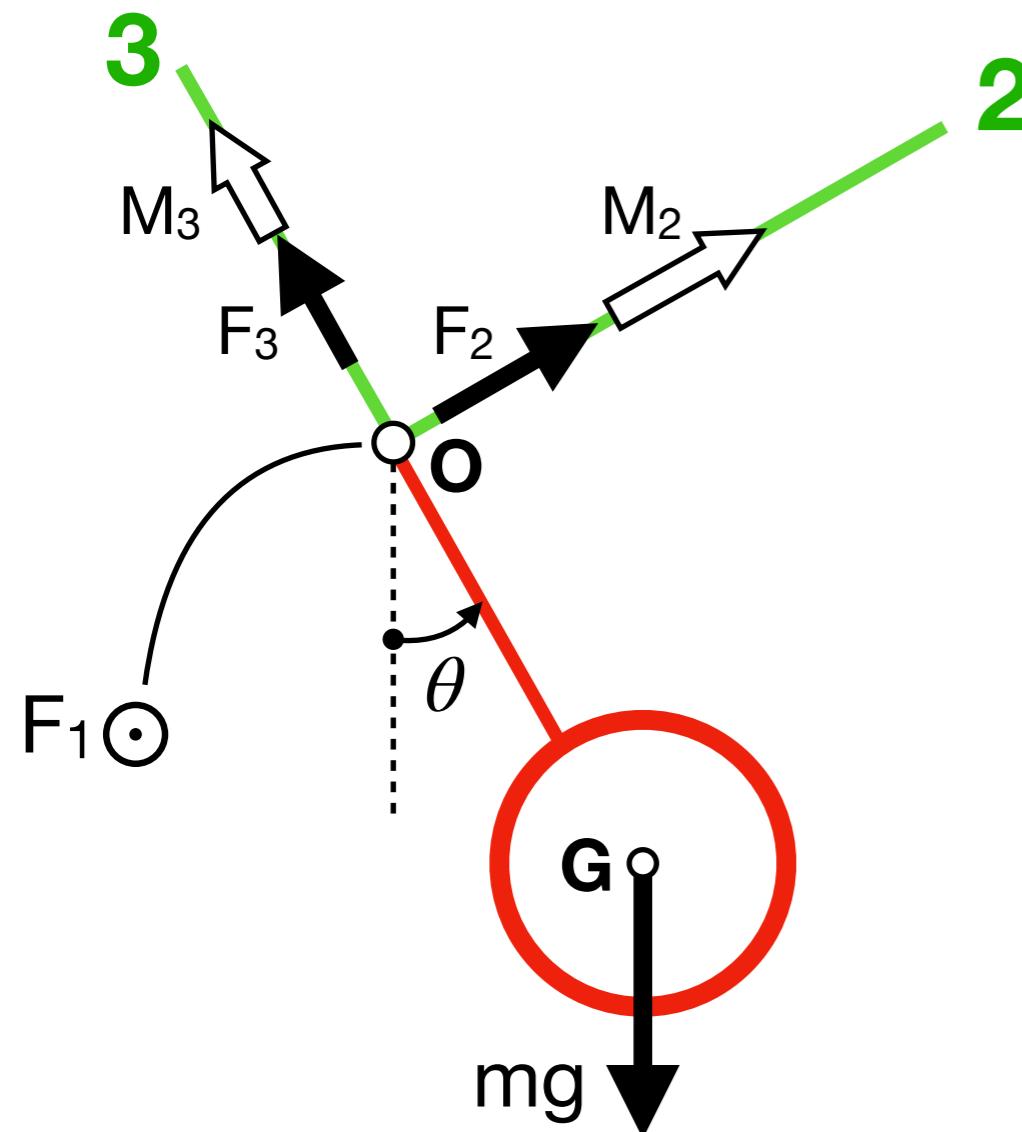
Problema

INDET



Sistema	Incògn.	Problema
Pèndol	$5 \text{ ie}, \ddot{x}, \ddot{\theta}$	INDET
Pènd. + sup.	$5 \text{ ie}, \ddot{x}, \ddot{\theta}$	INDET
Els altres sistemes tenen + incògnites !		

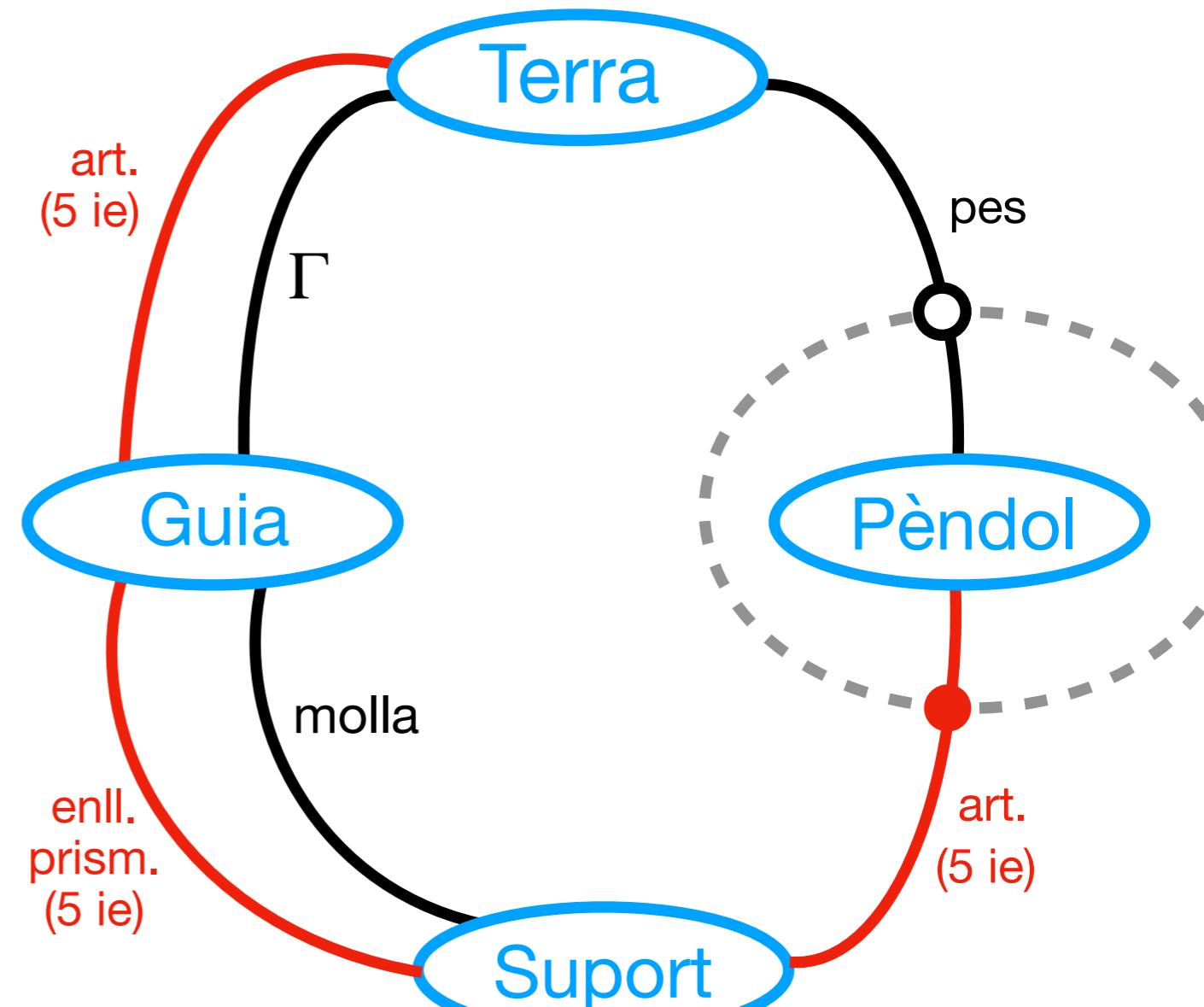
Sist = Pèndol



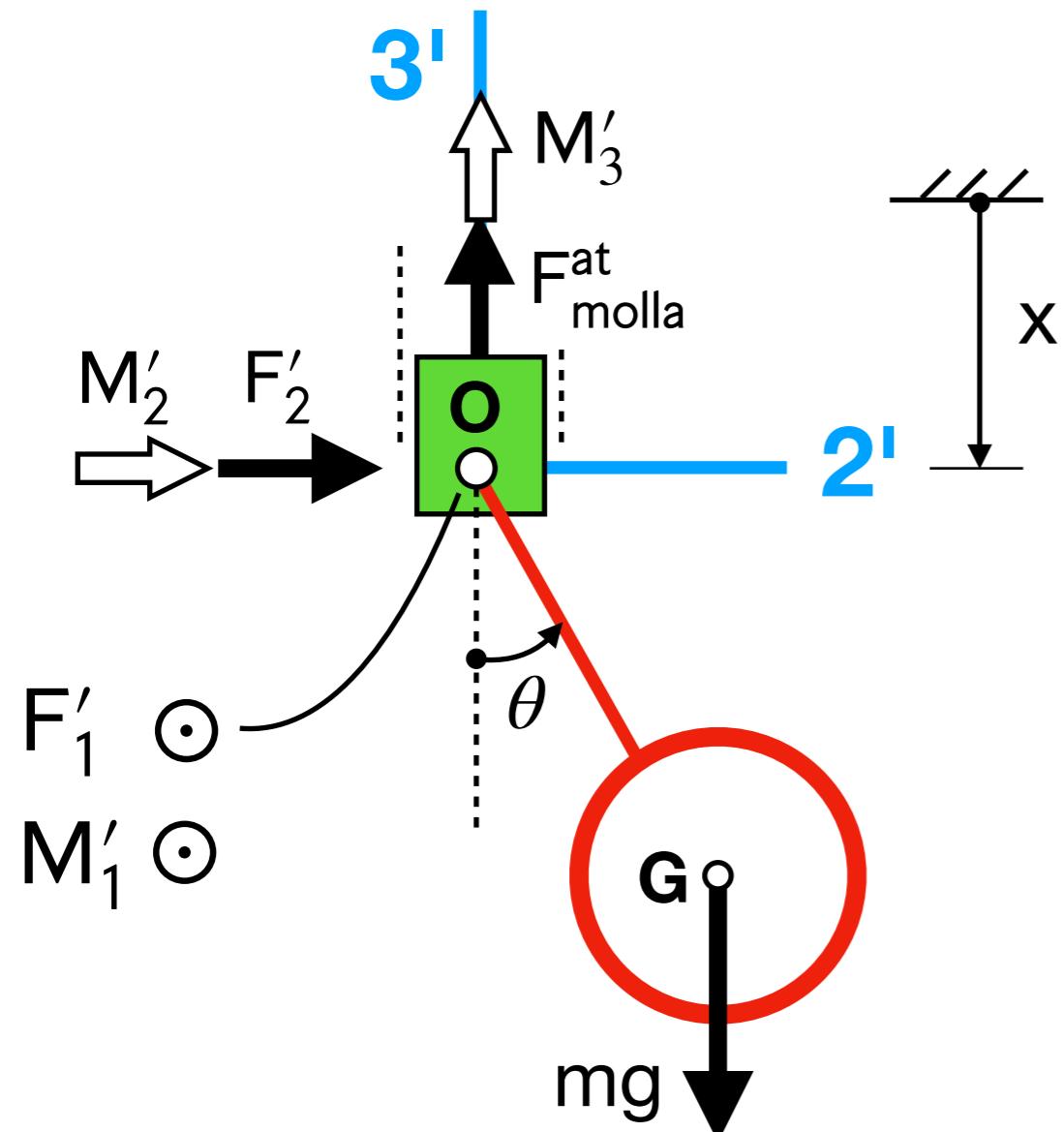
$$\left\{ \bar{F}_{\text{Sup} \rightarrow \text{Pendol}} \right\}_B = \left\{ \begin{array}{l} F_1 \\ F_2 \\ F_3 \end{array} \right\}$$

$$\left\{ \bar{M}_{\text{Sup} \rightarrow \text{Pendol}} (O) \right\}_B = \left\{ \begin{array}{l} 0 \\ M_2 \\ M_3 \end{array} \right\} \leftarrow \boxed{\text{TMC}(O)]_1}$$

Illiure de ie



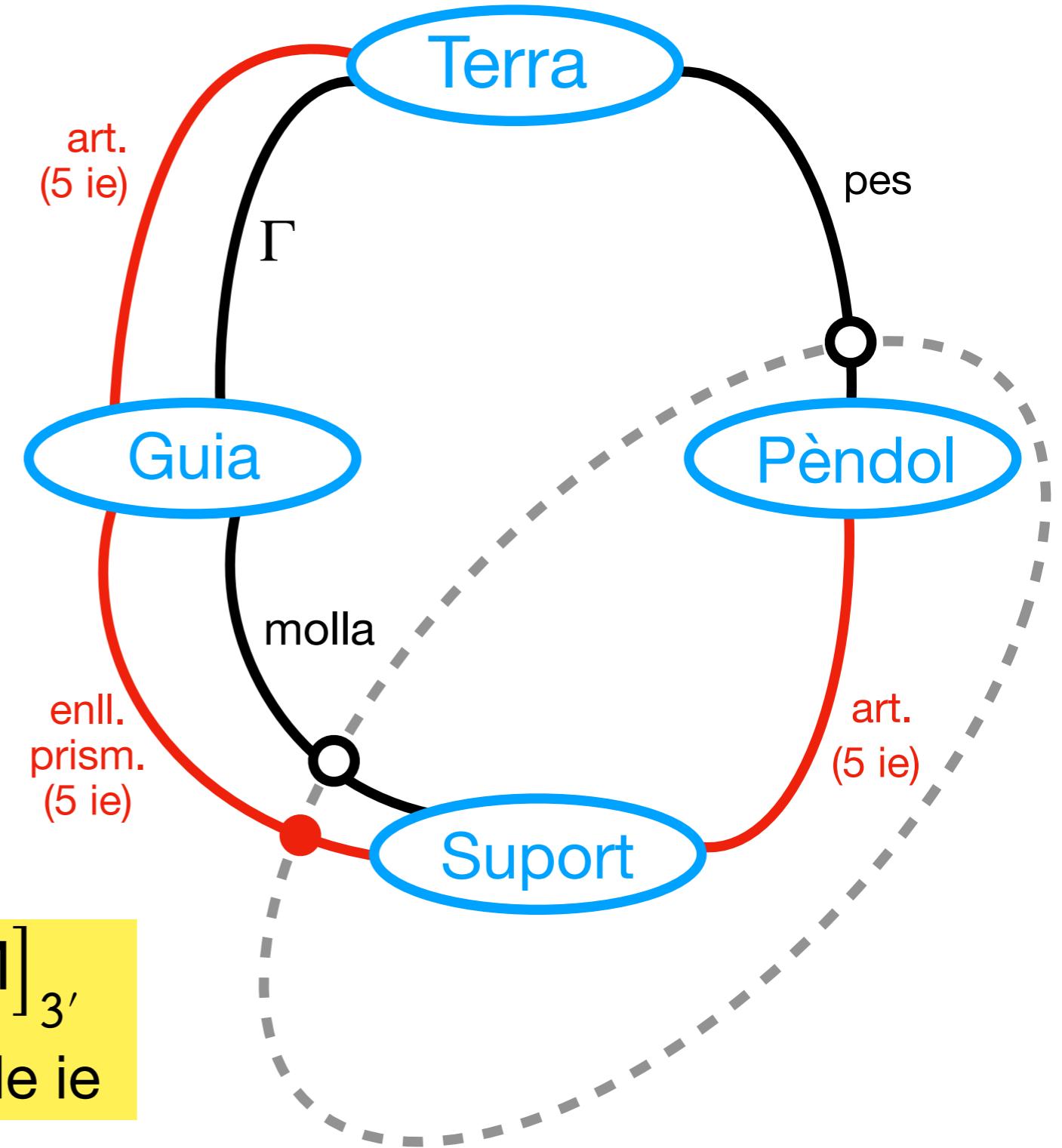
Sist = Pèndol + Suport



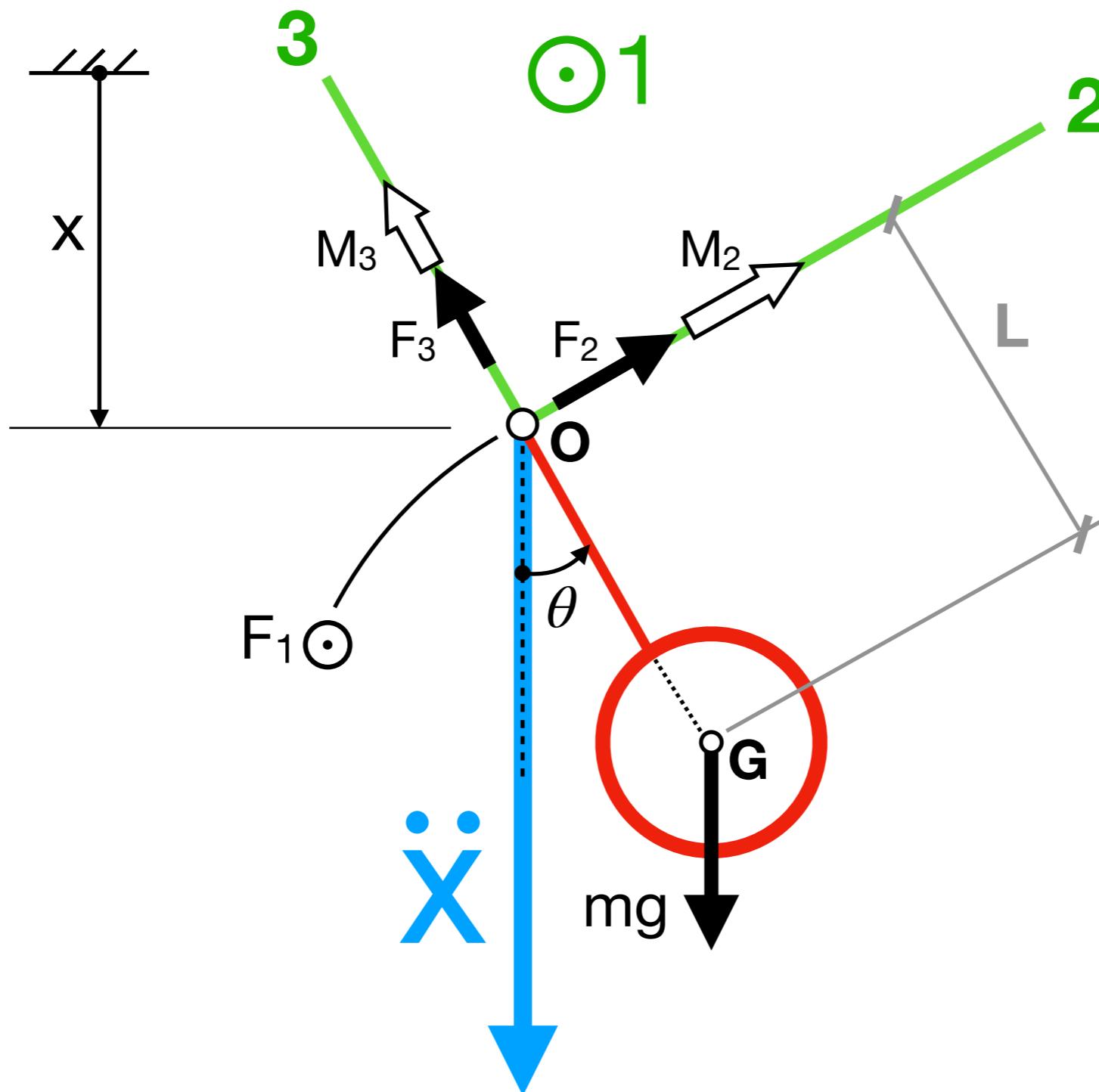
$$\left\{ \bar{F}_{\text{Guia} \rightarrow \text{Sup}} \right\}_{B'} = \begin{Bmatrix} F'_1 \\ F'_2 \\ 0 \end{Bmatrix}$$

$$\left\{ \bar{M}_{\text{Guia} \rightarrow \text{Sup}} (O) \right\}_{B'} = \begin{Bmatrix} M'_1 \\ M'_2 \\ M'_3 \end{Bmatrix}$$

TQM]_{3'}
lliure de ie



TMC(O)]₁ sobre SIST = Pèndol



TMC(O)]₁ sobre SIST = Pèndol

$$\left\{ \dot{\bar{H}}_{RTO}(O) \right\}_B = \left\{ \begin{array}{l} I_{11} \ddot{\theta} + (I_{33} - I_{22}) \dot{\psi}_0^2 \sin \theta \cos \theta \\ (I_{11} + I_{22} - I_{33}) \dot{\psi}_0 \dot{\theta} \cos \theta \\ (I_{22} - I_{11} - I_{33}) \dot{\psi}_0 \dot{\theta} \sin \theta \end{array} \right\} \quad (III)$$

Pas final

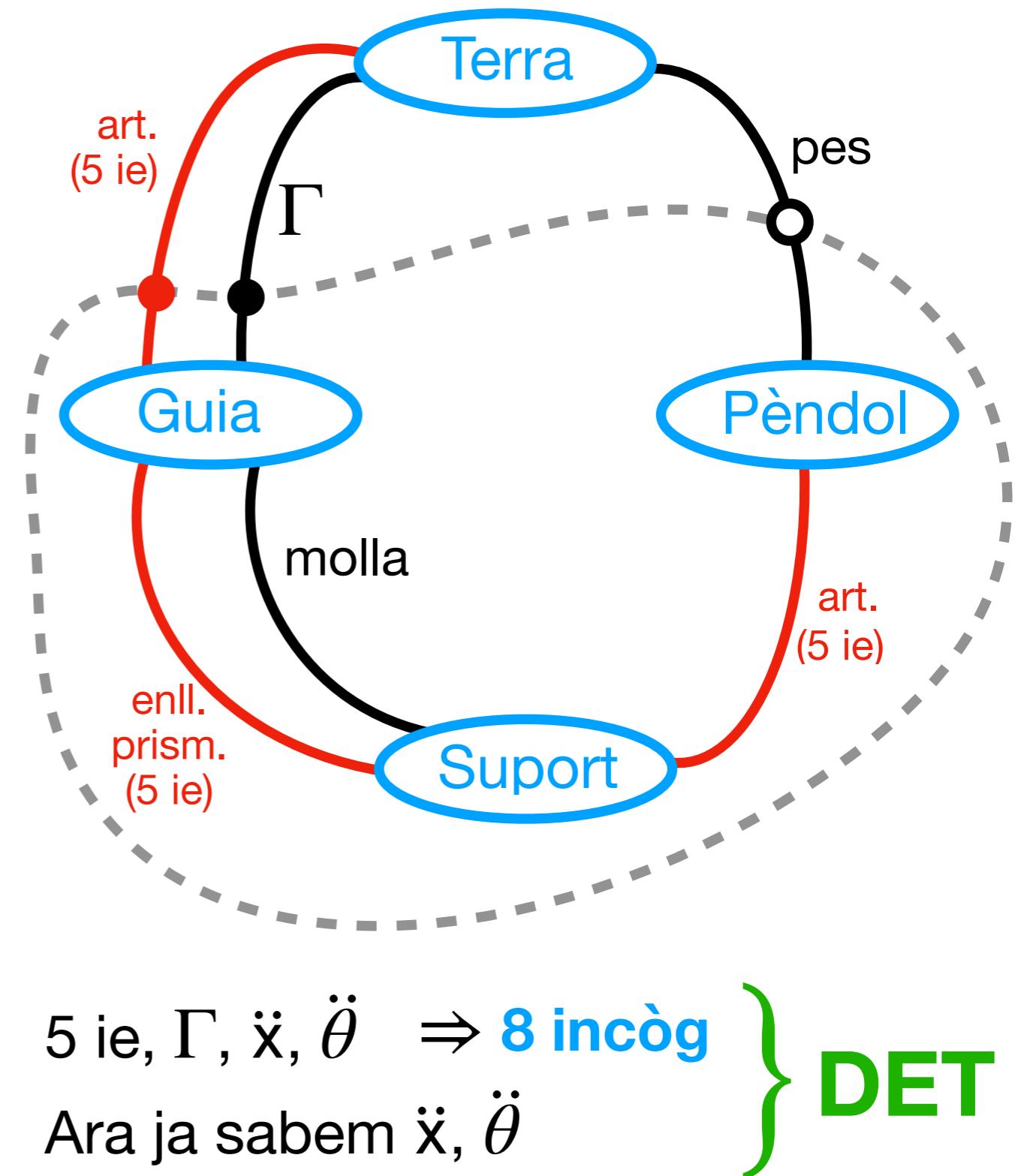
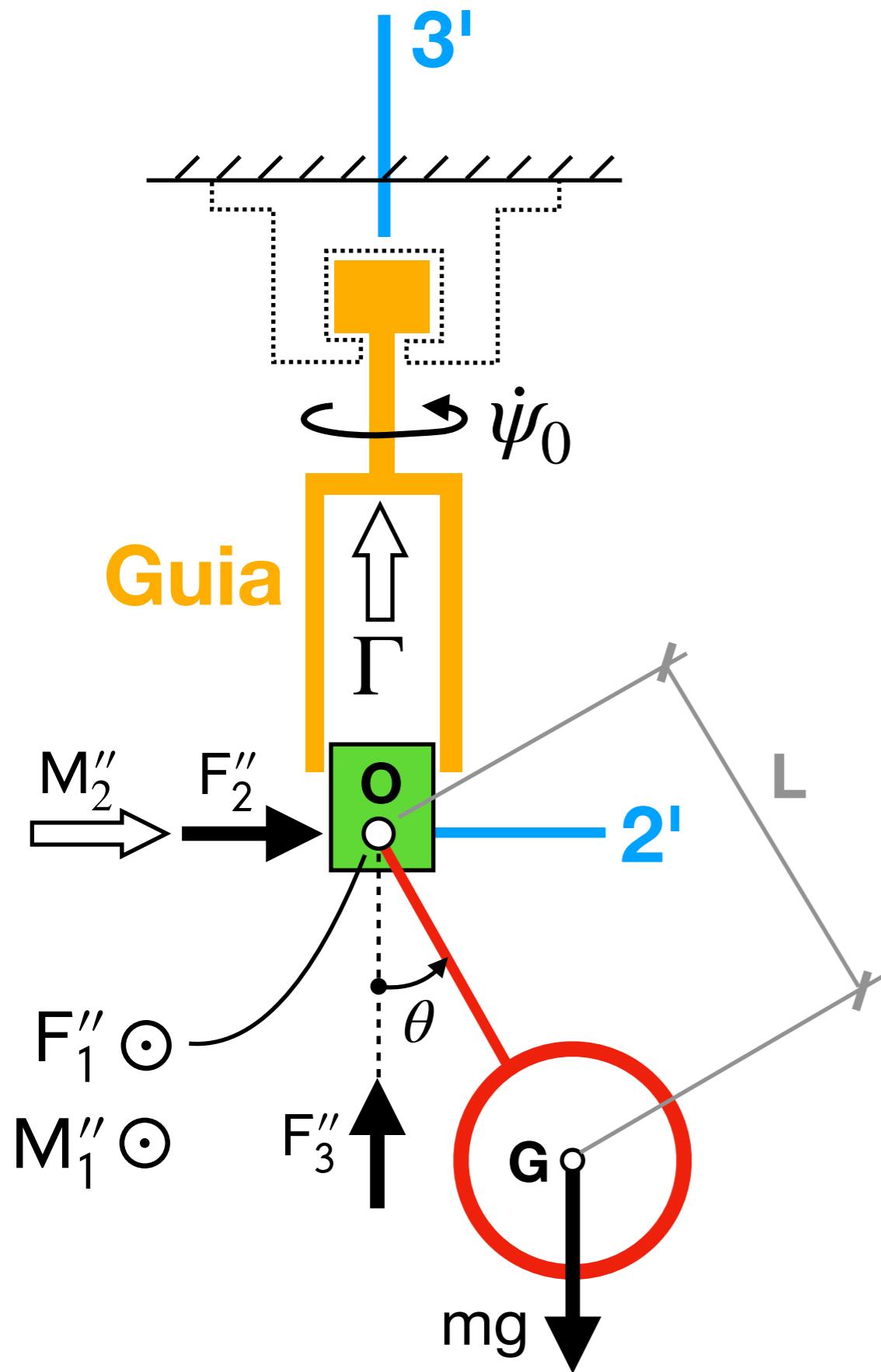
$$\left\{ \begin{array}{l} (R^2 + L^2) \ddot{\theta} - (L \sin \theta) \ddot{x} = (L \dot{\psi}_0^2 \cos \theta - g) L \sin \theta \\ - (L \sin \theta) \ddot{\theta} + \ddot{x} = - \frac{k}{m} x + L \dot{\theta}^2 \cos \theta \end{array} \right.$$

Aillant $\ddot{\theta}$ i \ddot{x}

$$\left\{ \begin{array}{l} \ddot{\theta} = F_1(\theta, \dot{\theta}, x, \dot{x}) \\ \ddot{x} = F_2(\theta, \dot{\theta}, x, \dot{x}) \end{array} \right. \begin{array}{l} \text{Eq. mov. } \theta \\ \text{Eq. mov. } x \end{array}$$

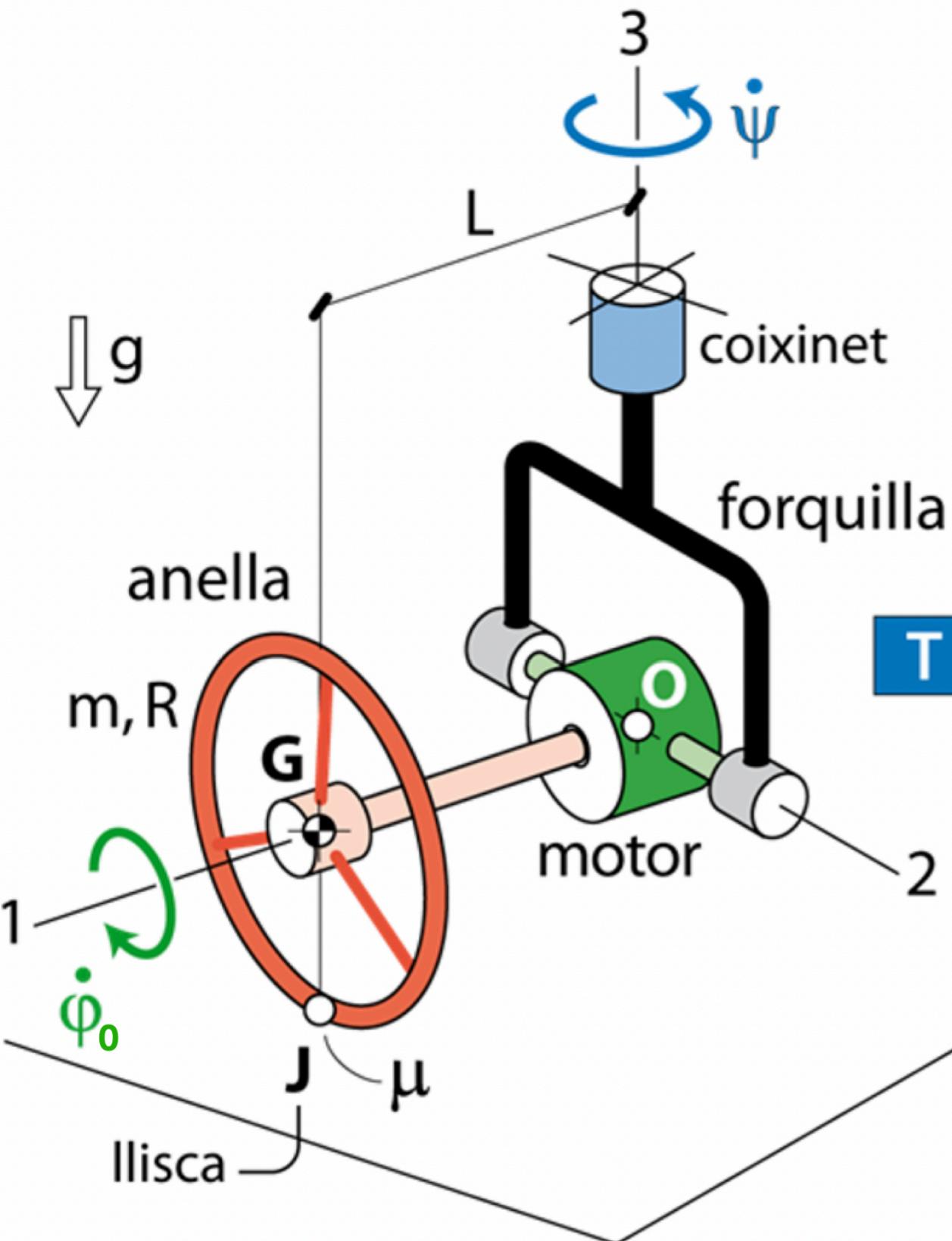
No cal
que el feu

Parell motor per mantenir $\dot{\psi}_0 = \text{ct}$



D'abans

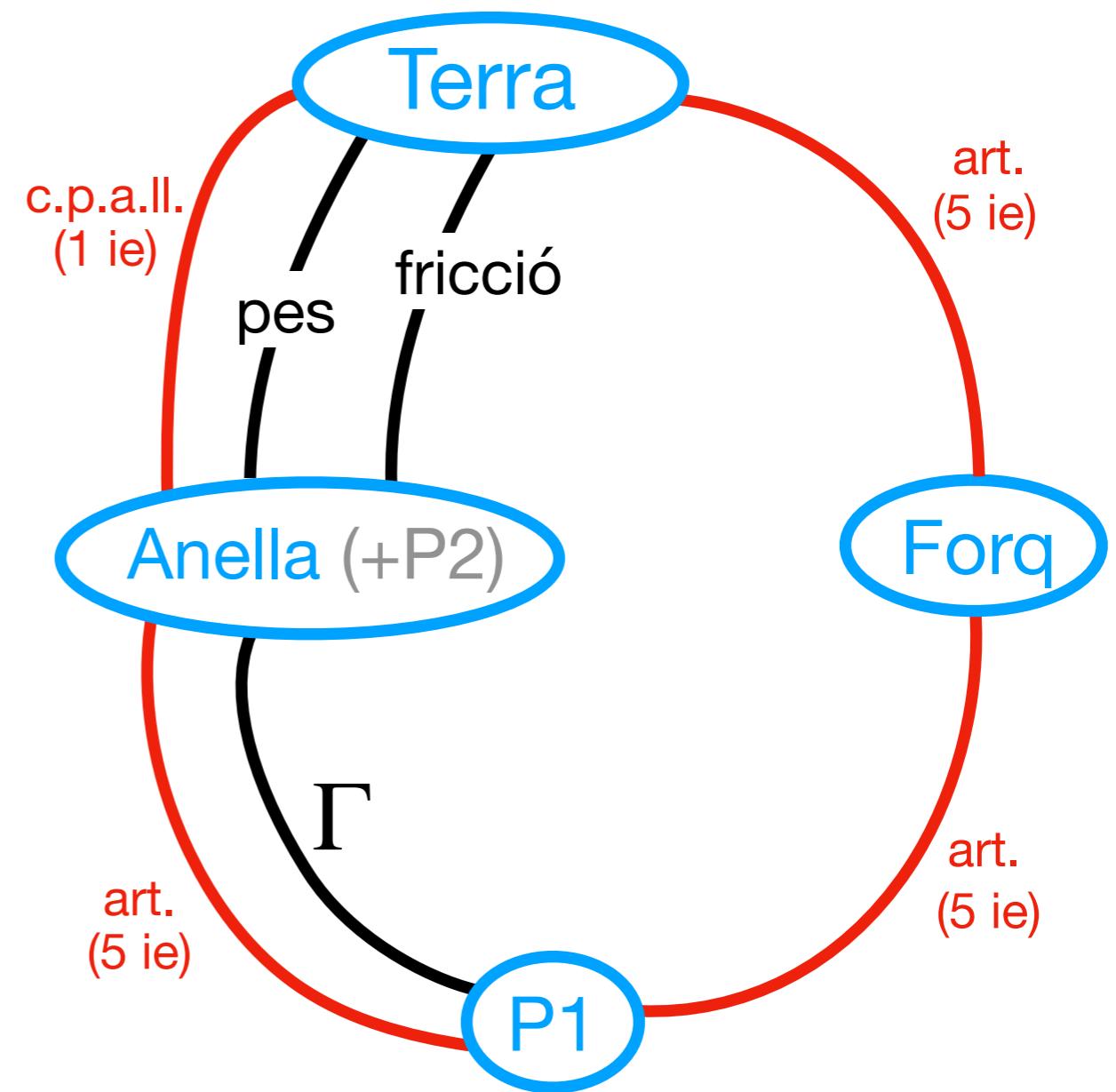
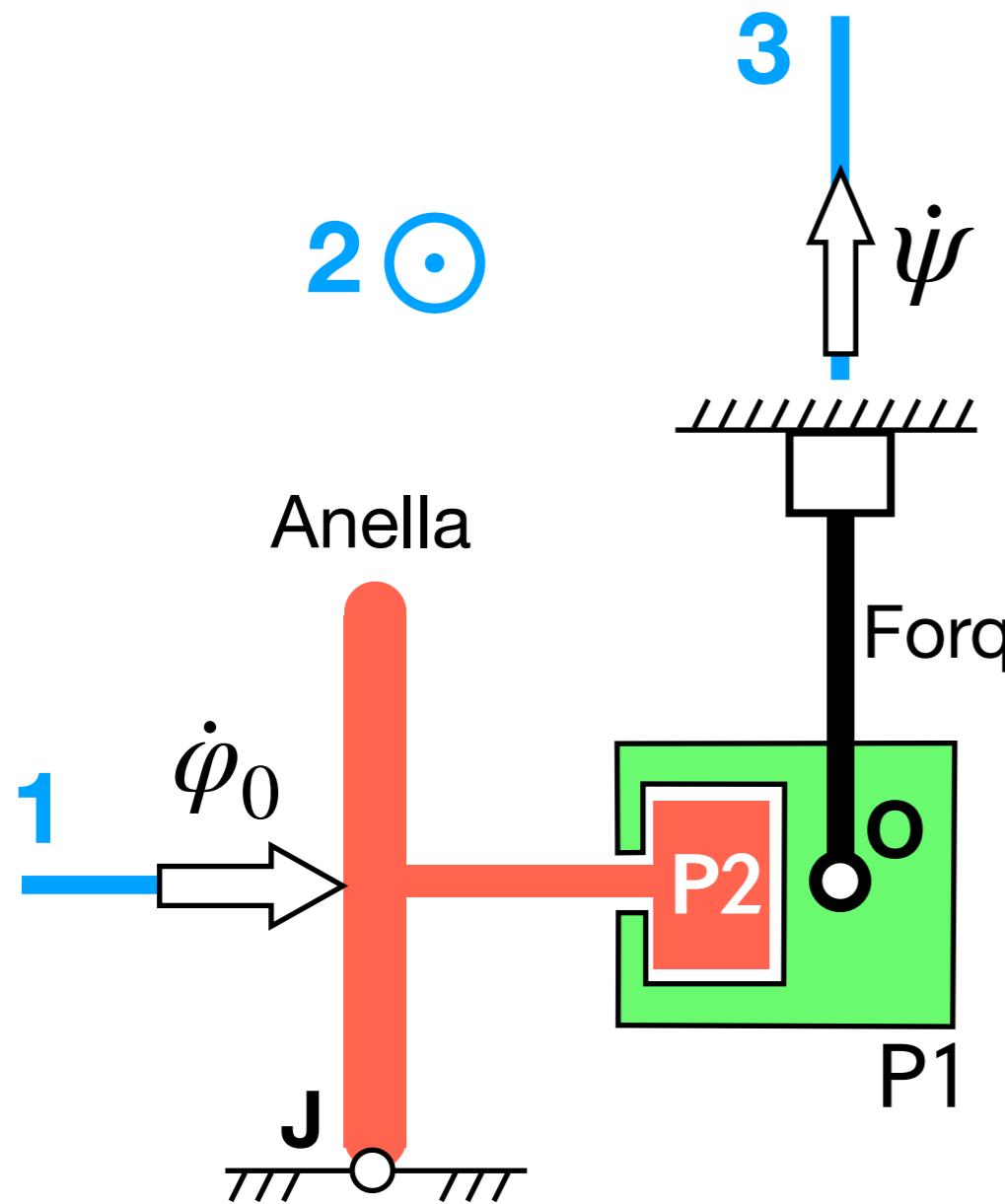
$$\left\{ \dot{\bar{H}}_{RTO}(\mathbf{O}) \right\}_B = \left\{ \begin{array}{l} I_{11} \ddot{\theta} + (I_{33} - I_{22}) \dot{\psi}_0^2 \sin \theta \cos \theta \\ (I_{11} + I_{22} - I_{33}) \dot{\psi}_0 \dot{\theta} \cos \theta \\ (I_{22} - I_{11} - I_{33}) \dot{\psi}_0 \dot{\theta} \sin \theta \end{array} \right\} = \left\{ \begin{array}{l} \dot{H}_1 \\ \dot{H}_2 \\ \dot{H}_3 \end{array} \right\}$$



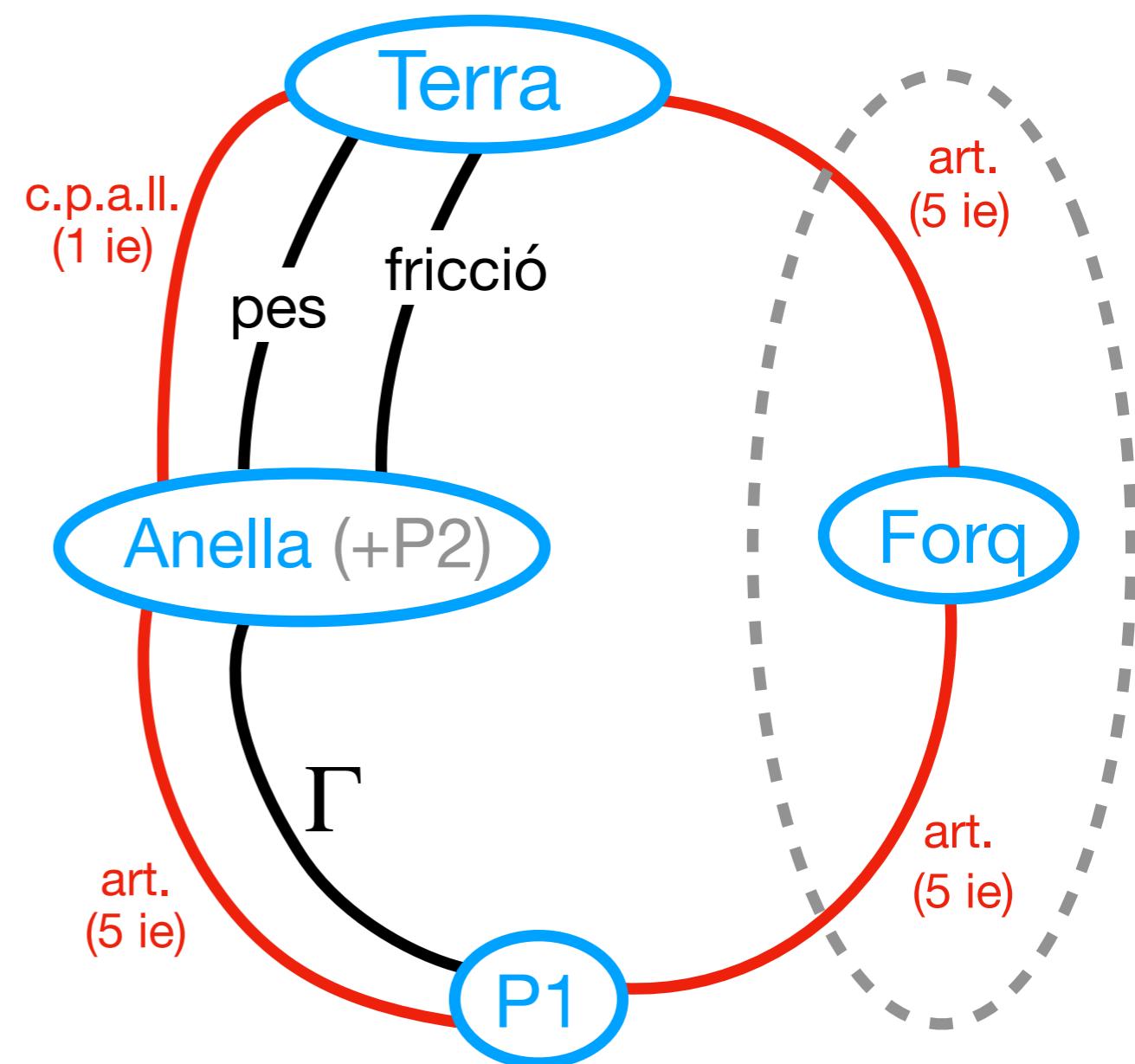
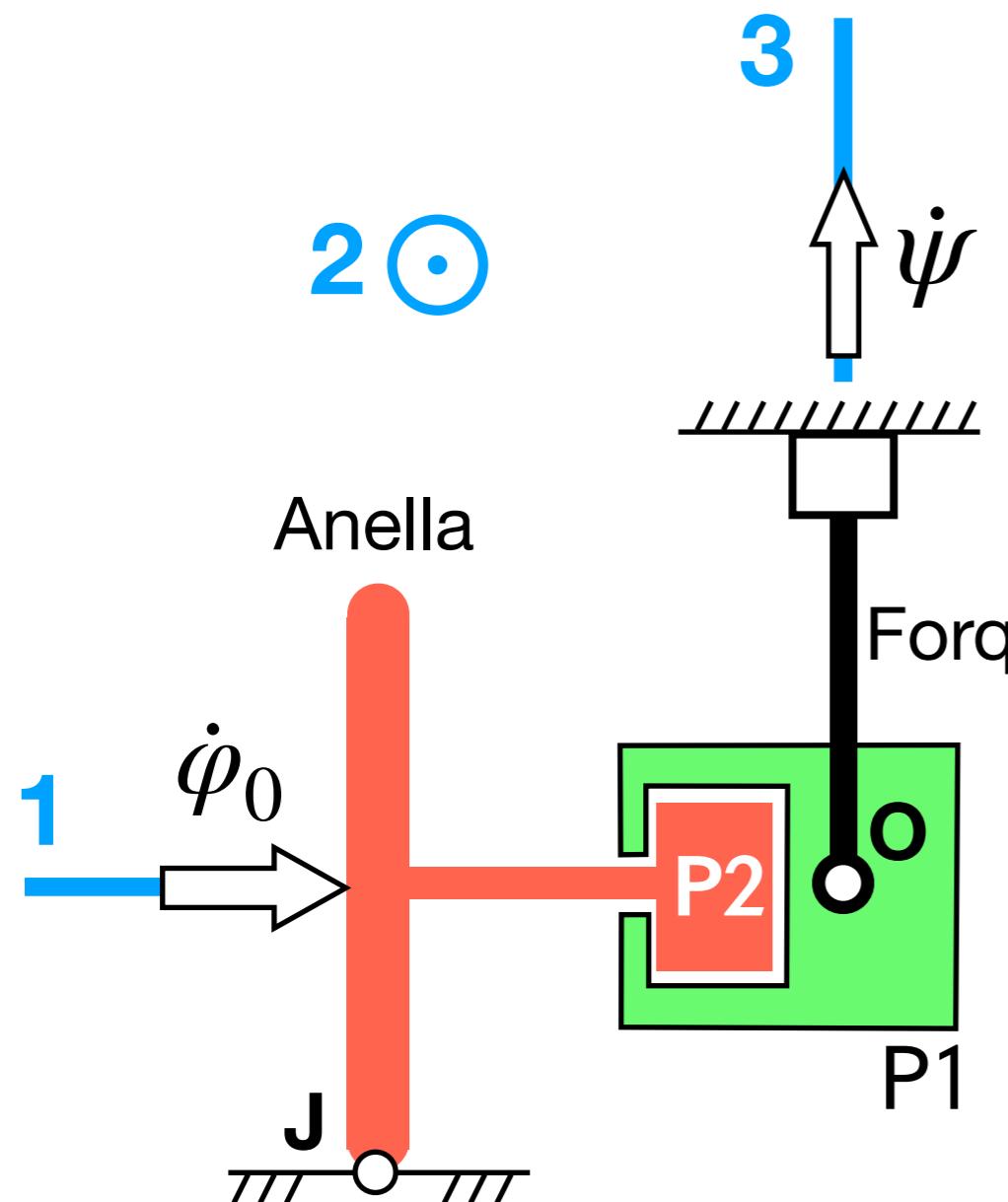
- GL sistema?
- DGI
- Caracterització de torsors?
- Eq. mov per a la coord. ψ
- Força normal a J
- Parell motor per mantenir $\dot{\phi}_0$

Manté contacte puntual a J

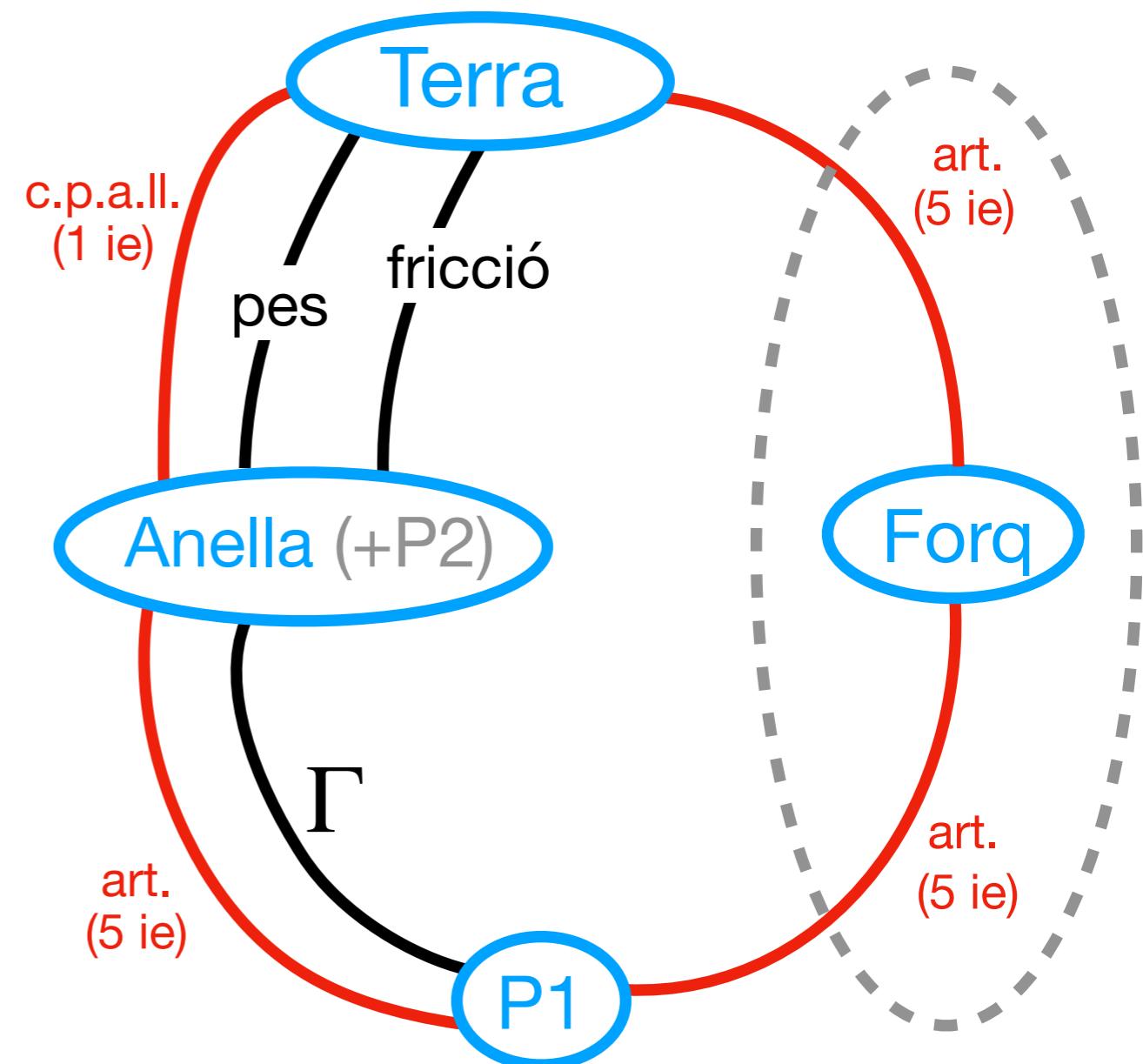
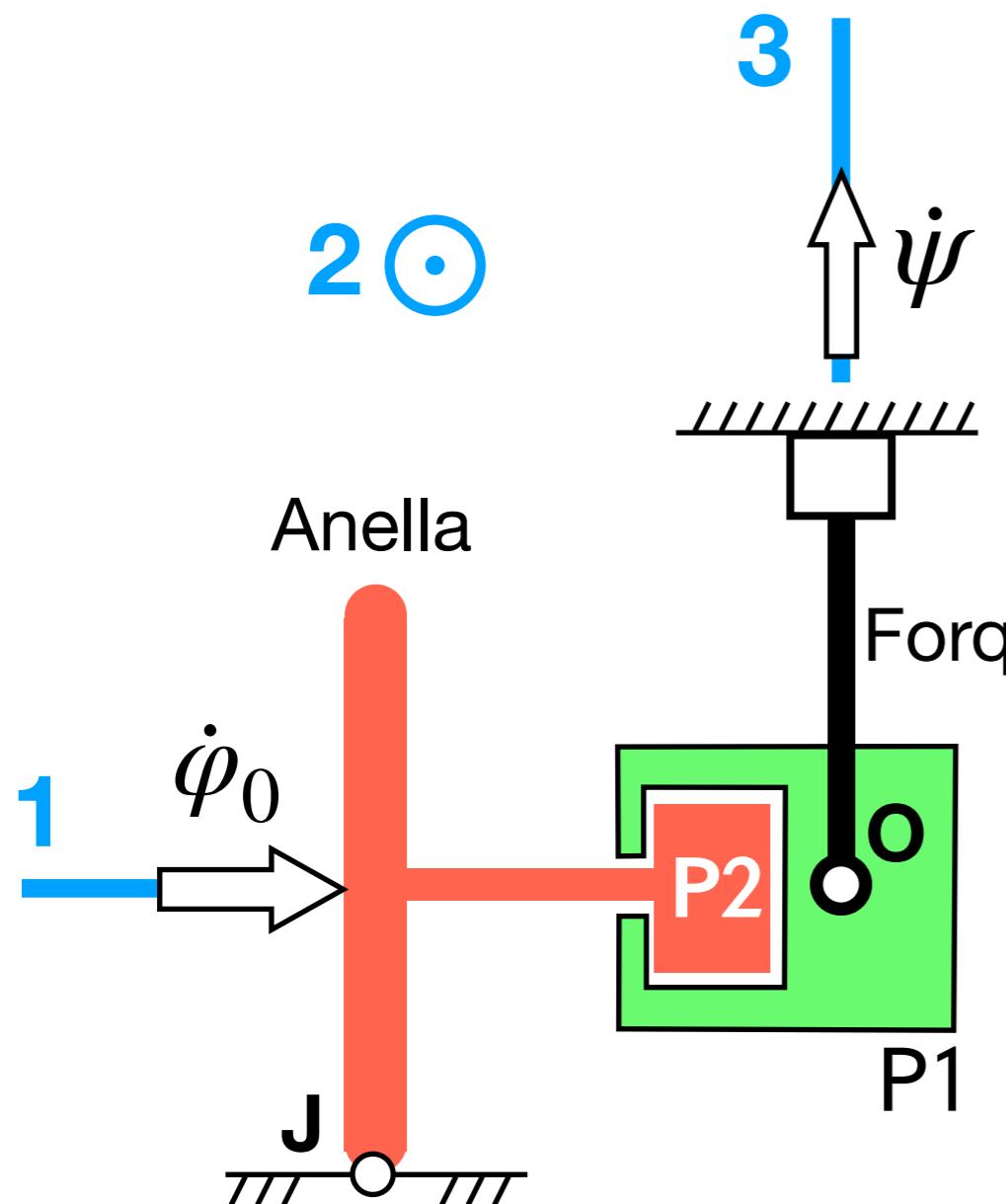
Motor manté $\dot{\phi}_0 = \text{ct}$



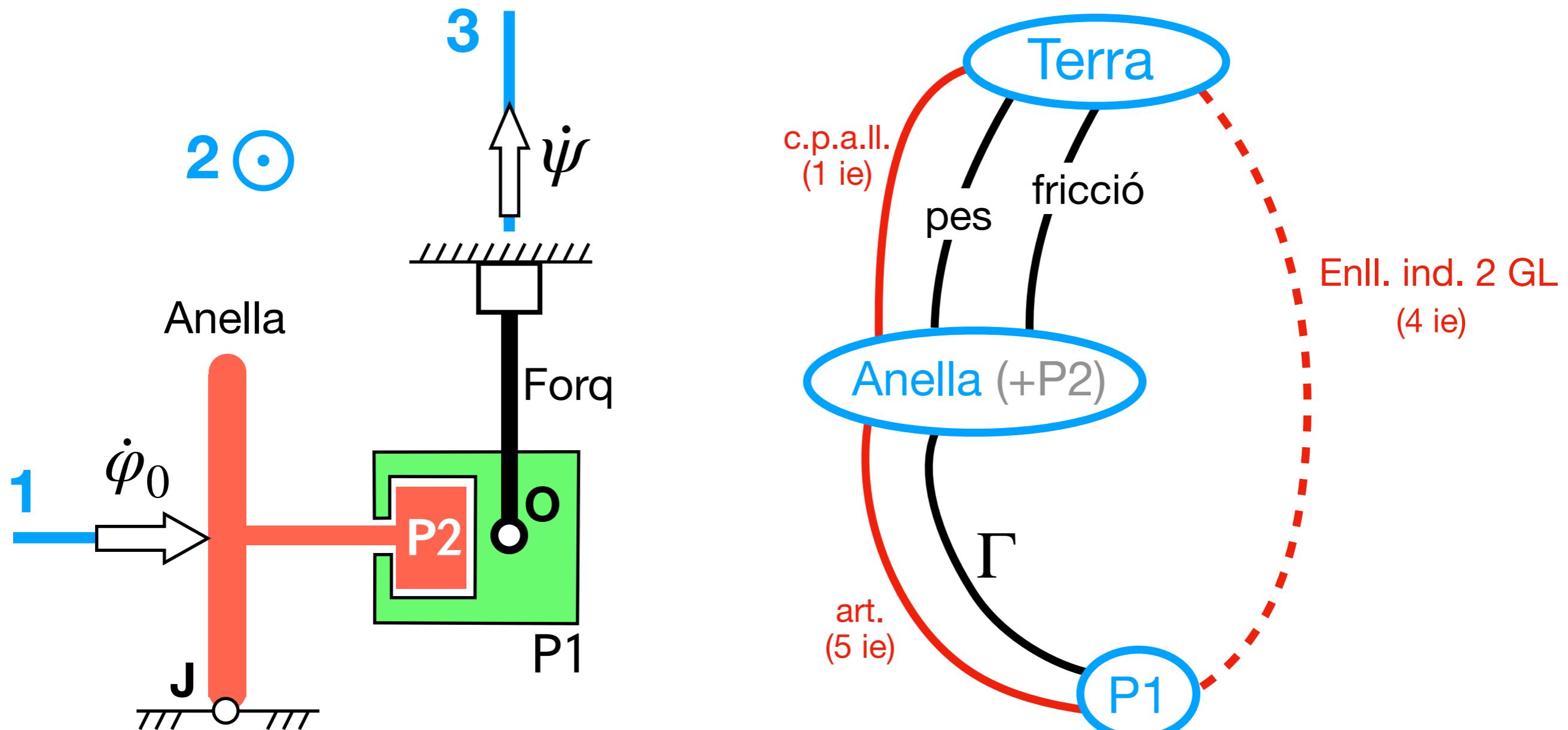
Forq és SAE ...



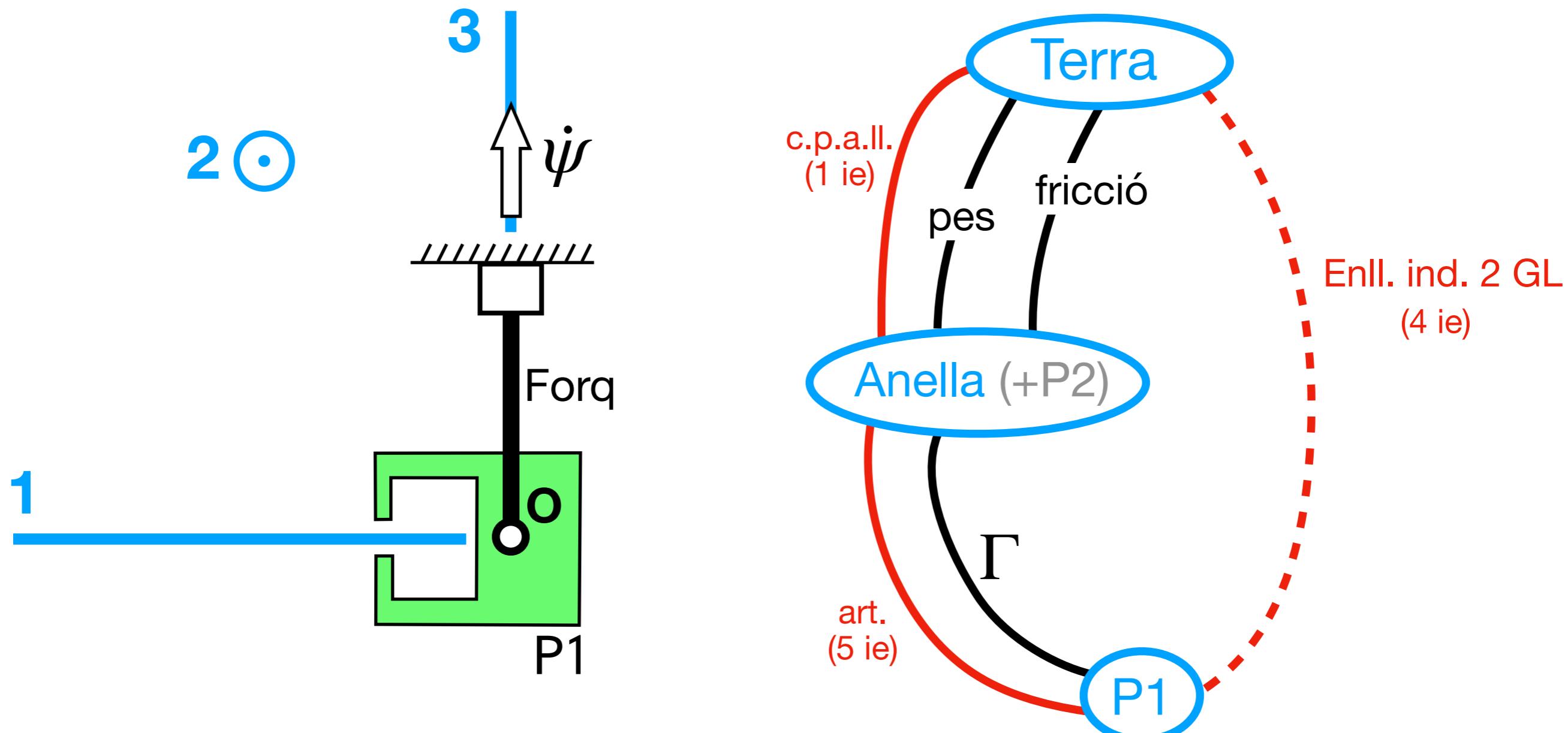
Substituim Forq per enllaç indirecte $T \rightarrow P_1$



Substituim Forq per enllaç indirecte $T \rightarrow P_1$



Substituim Forq per enllaç indirecte $T \rightarrow P_1$

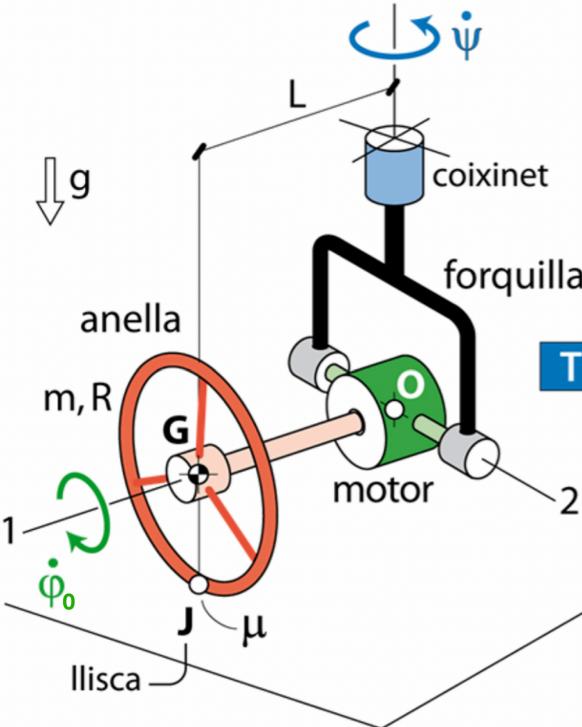


Torsor d'enllaç indirecte $T \rightarrow P_1$ al punt **O**:

$$\left\{ \bar{F}_{T \rightarrow (\text{forq}) \rightarrow \text{Sup}} \right\}_B = \begin{Bmatrix} F_1 \\ F_2 \\ F_3 \end{Bmatrix} \quad \text{O fix a T}$$

$$\left\{ \bar{M}_{T \rightarrow (\text{forq}) \rightarrow \text{Sup}} (\mathbf{O}) \right\}_{B'} = \begin{Bmatrix} M_1 \\ 0 \\ 0 \end{Bmatrix} \quad \begin{matrix} 0 \text{ en les rotacions} \\ \text{permeses de P1} \\ \text{resp T} \end{matrix}$$

Full ruta per eq. del mov. ψ

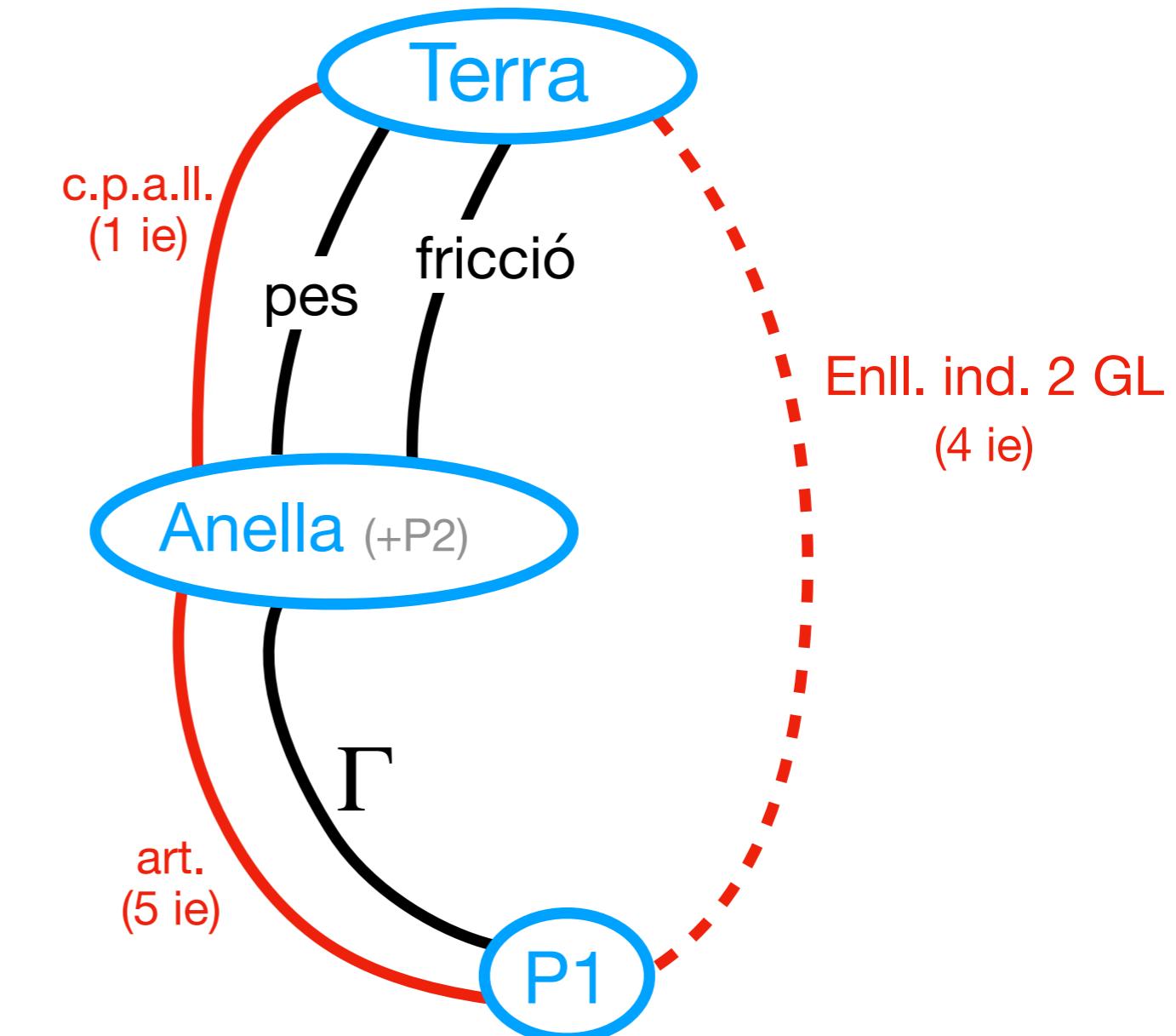


ψ afecta la cinemàtica
de **P1** i **Anella**



Sist ha d'incloure **P1** o **Anella**
(o ambdós)

Sistema	Incògn.	Problema
Anella	6 ie, Γ , $\ddot{\psi}$	INDET
P1	9 ie, Γ , $\ddot{\psi}$	INDET
Anella + P1	5 ie, $\ddot{\psi}$	DET



⇒ Triem SIST = Anella + P1