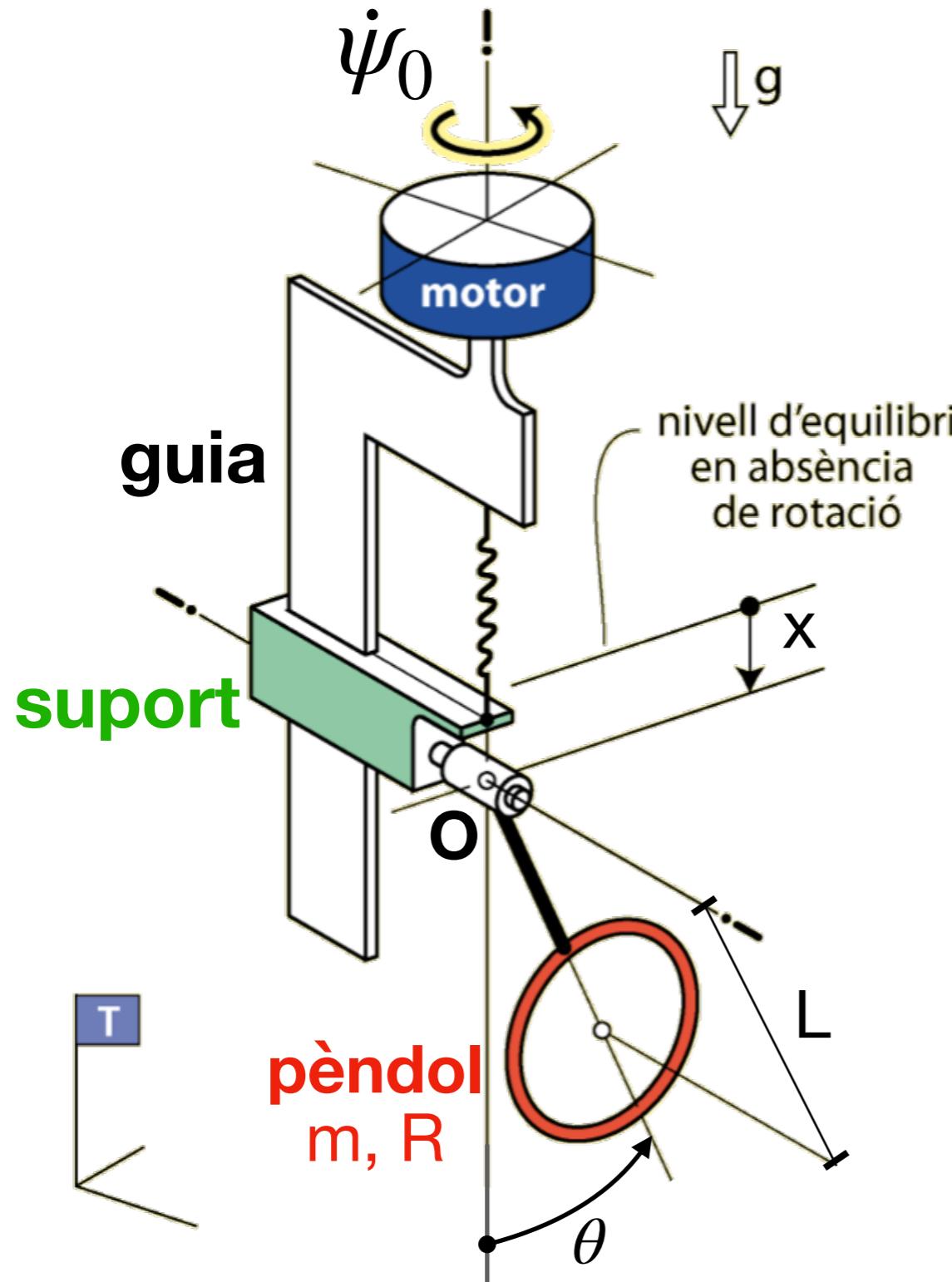


13P

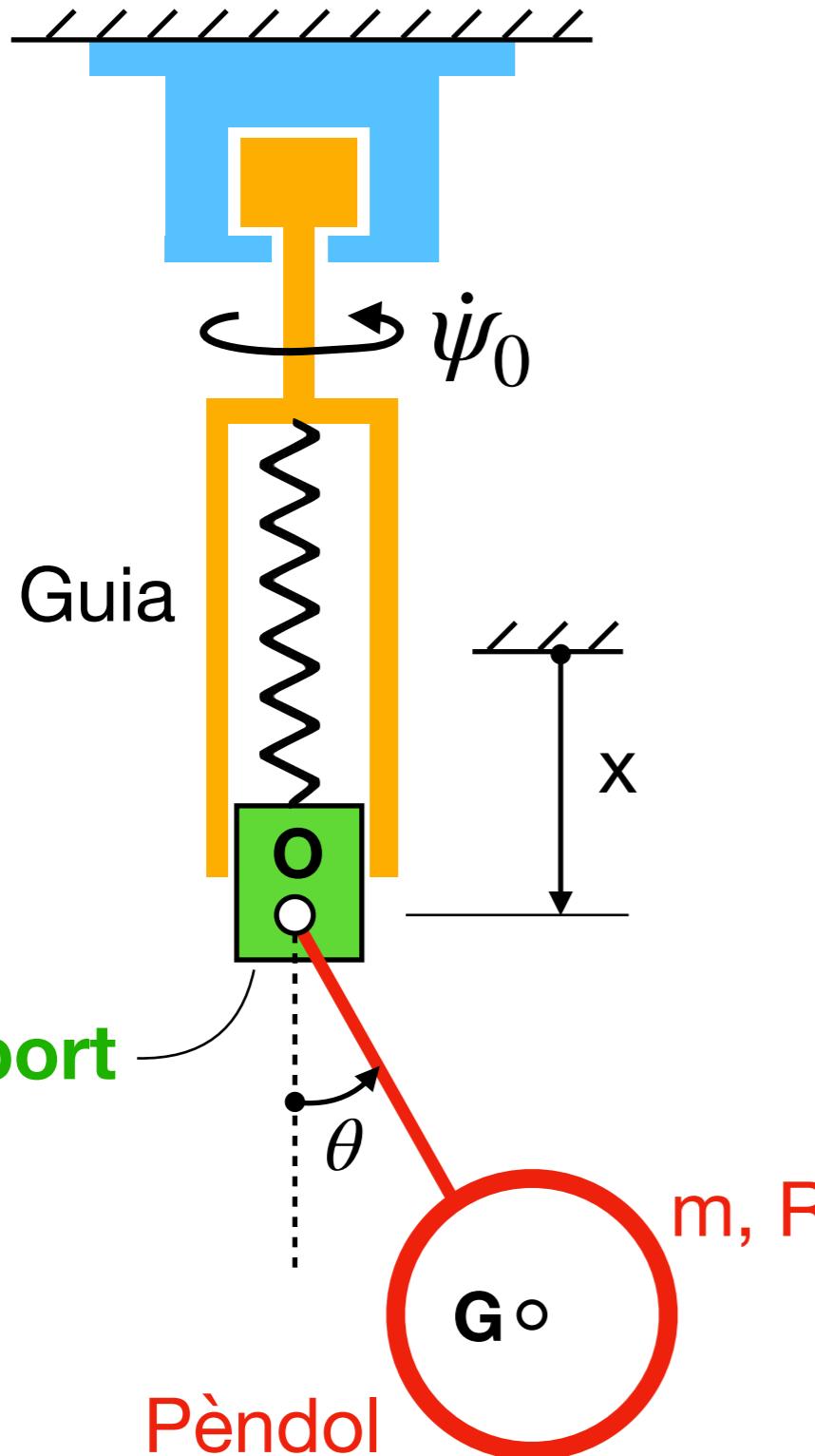
Teoremes vectorials III

Exemples 3D



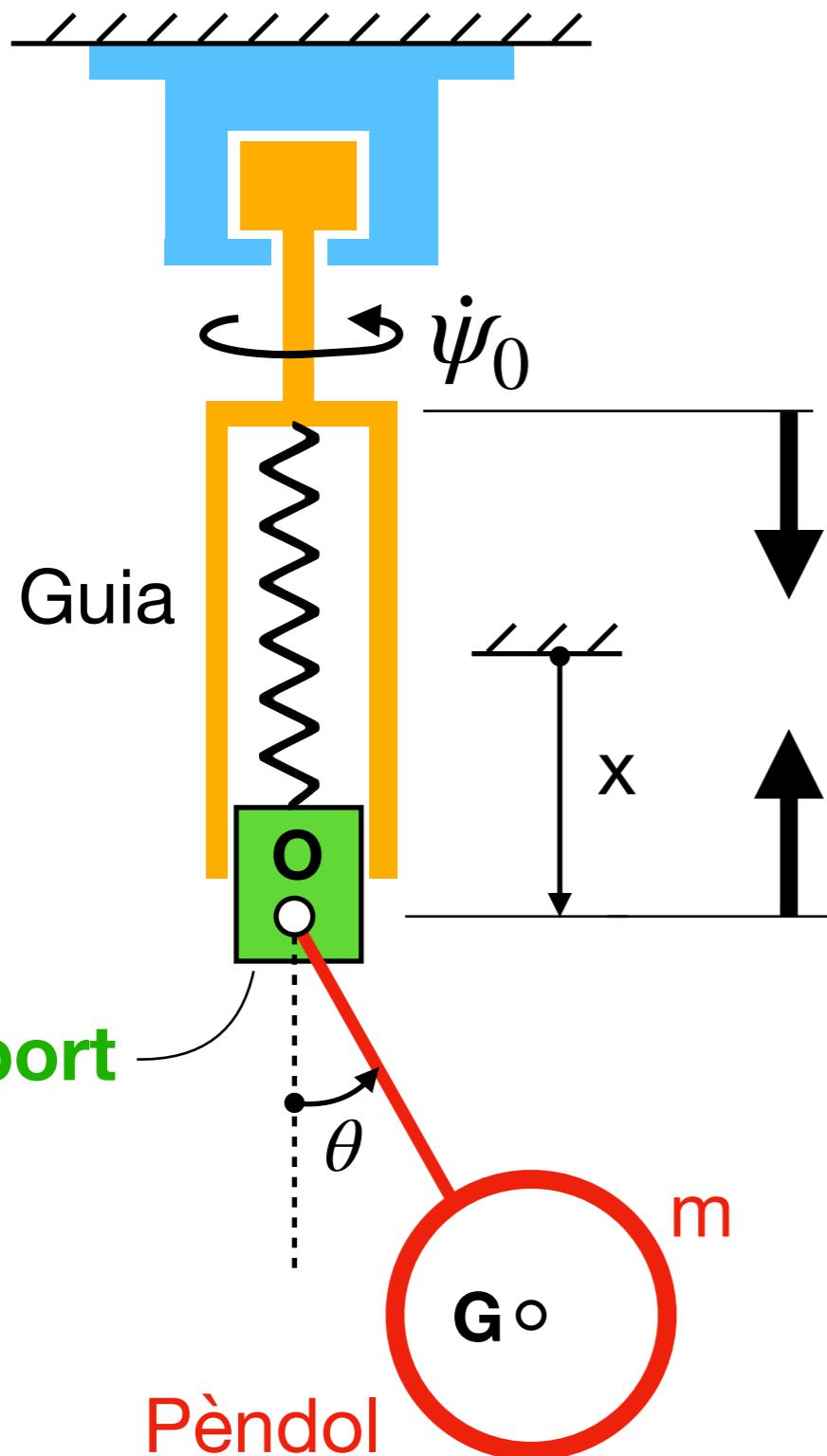
- DGI
- Eqs. mov. per a x i θ
- Parell motor Γ per mantenir $\dot{\psi}_0 = \text{ct}$

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

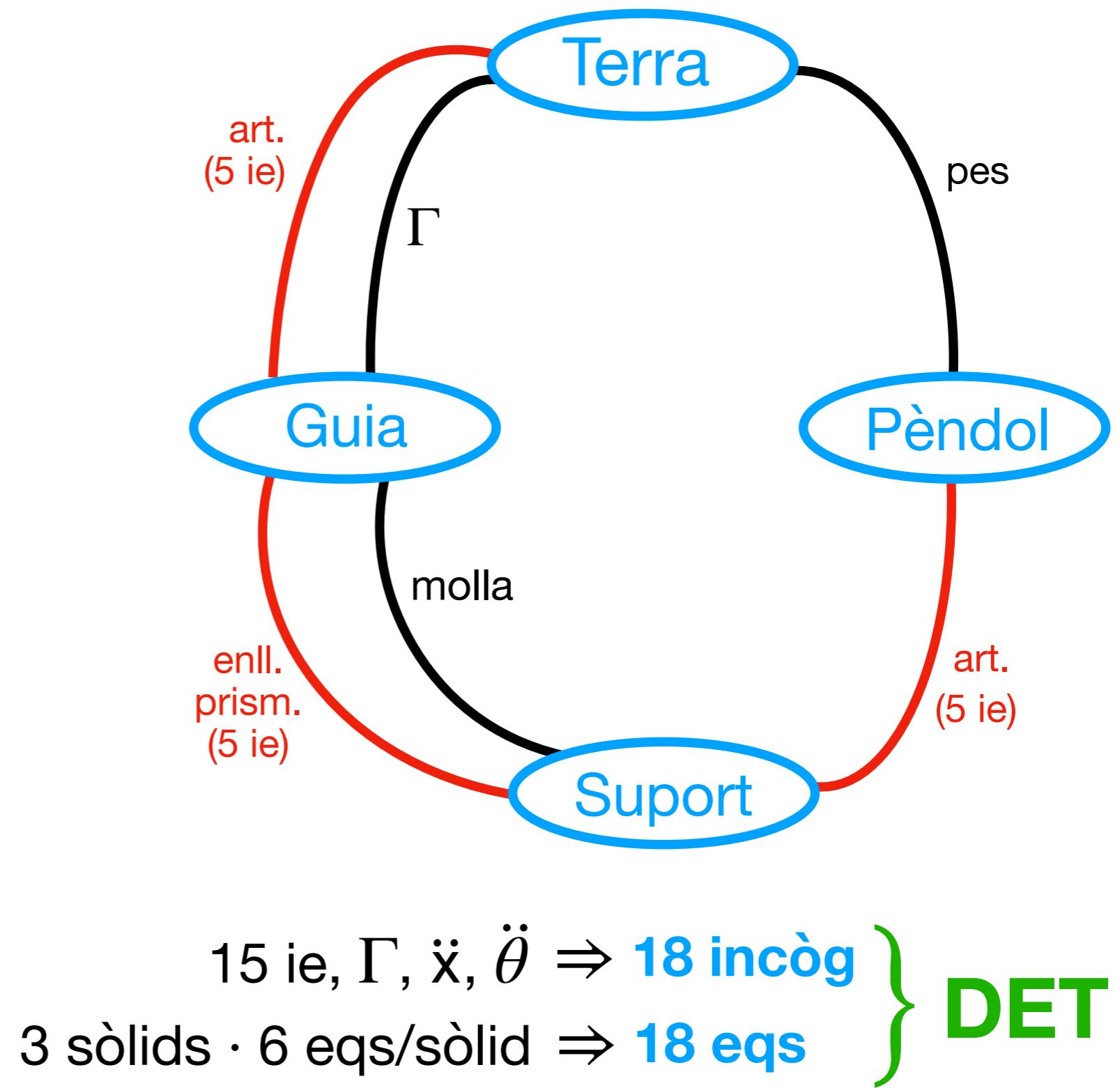
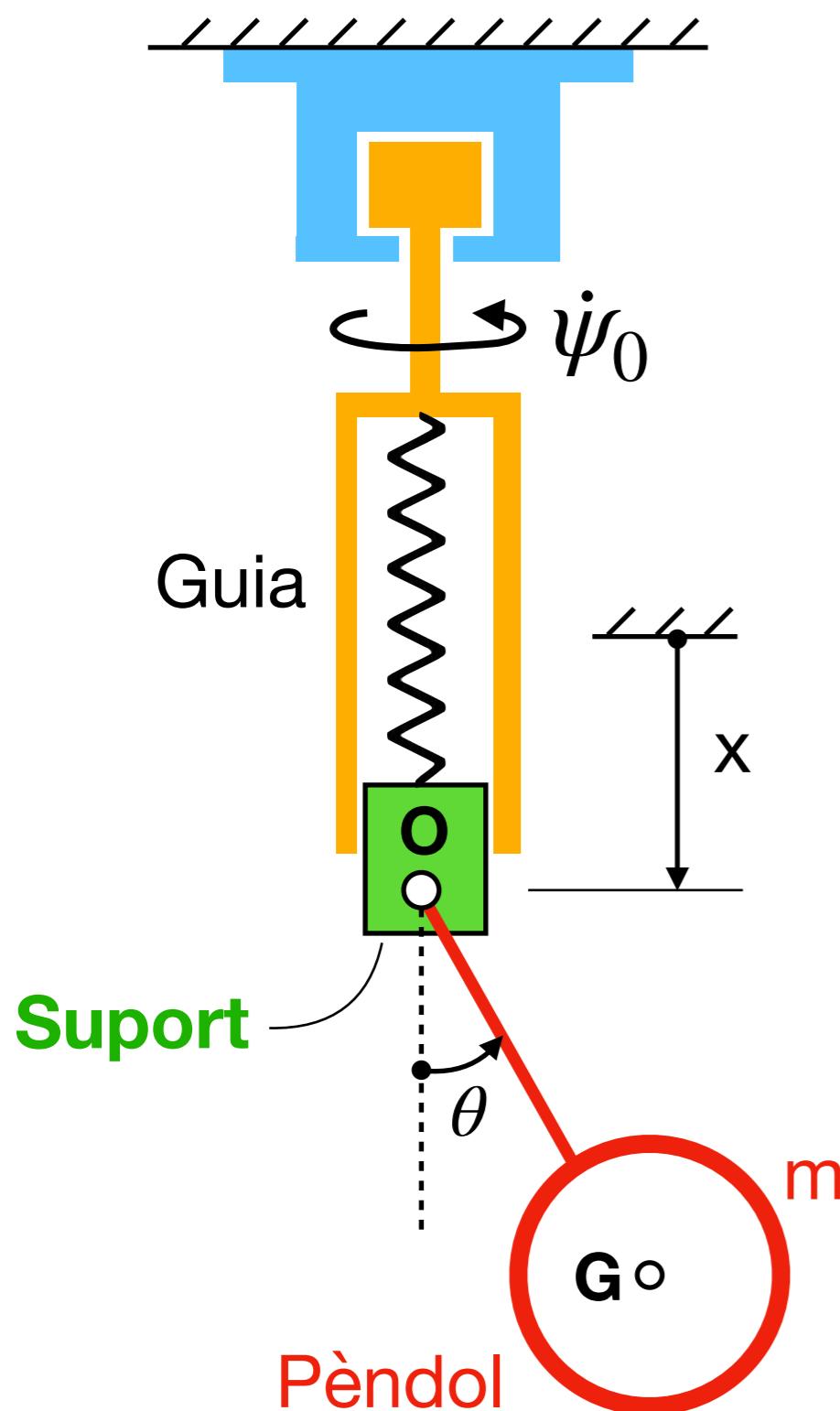


Força de la molla ?

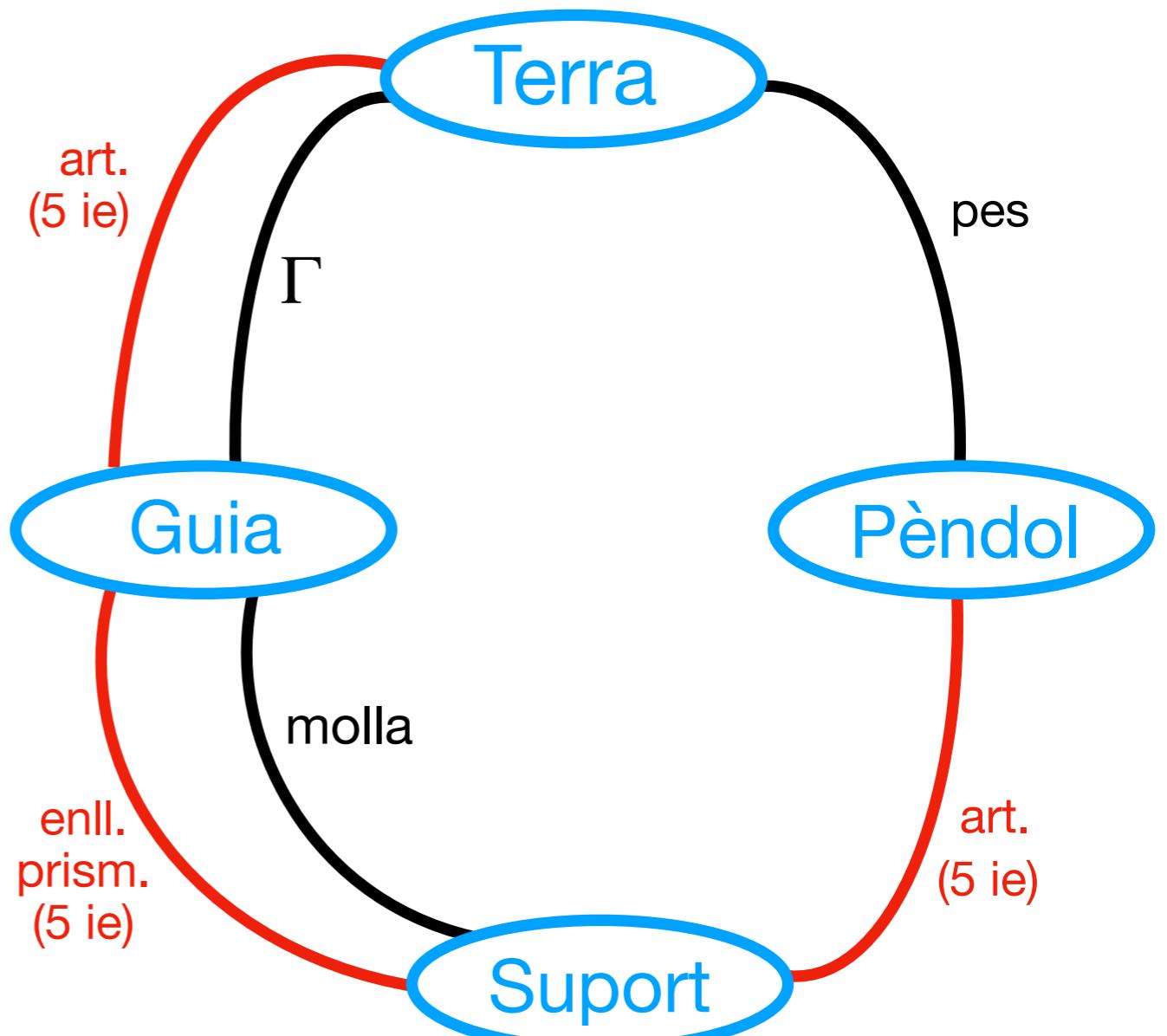
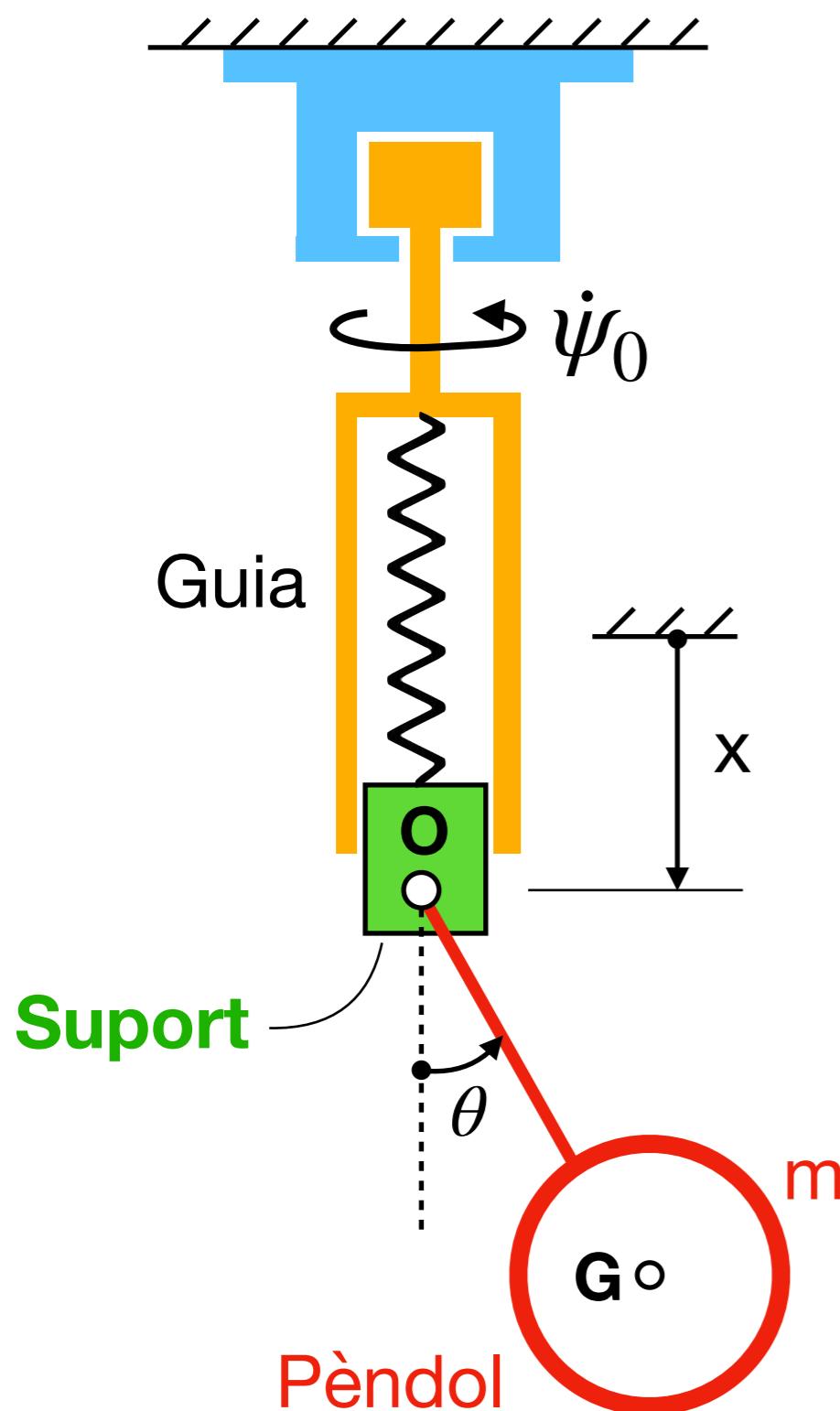
$$F_{\text{at molla}} = \underbrace{mg}_{F_0} + \underbrace{kx}_{k\Delta\rho}$$

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

DGI

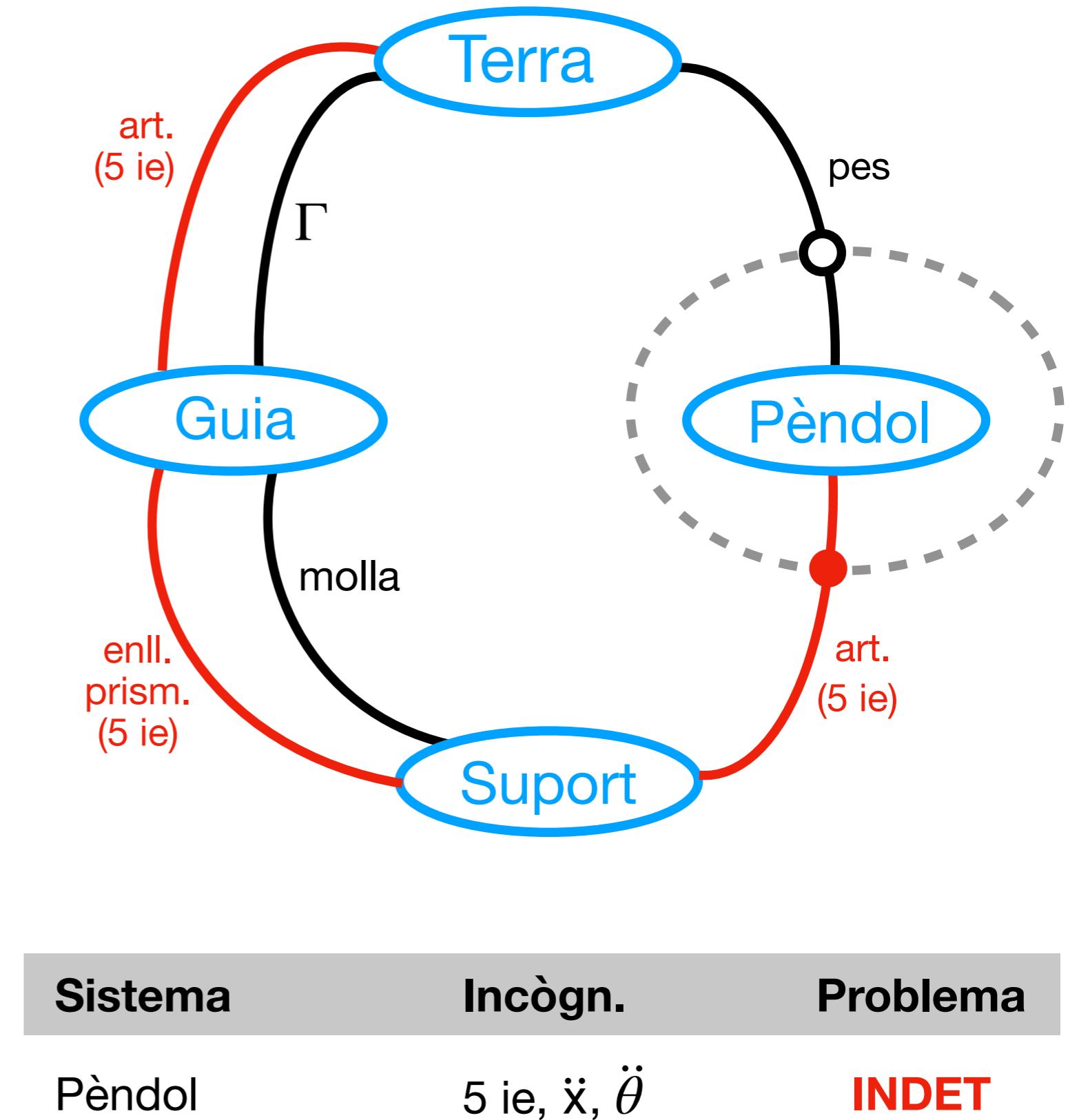
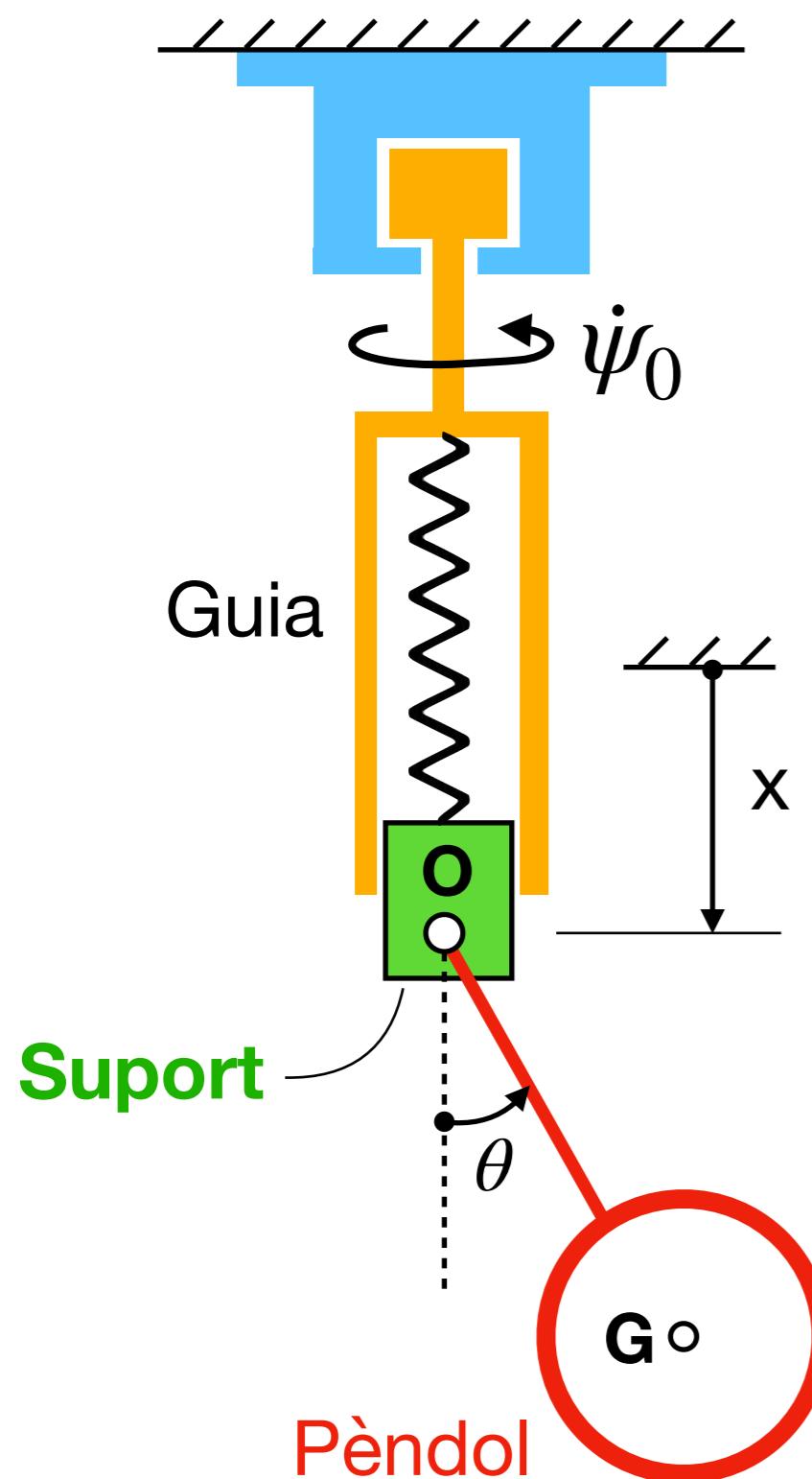


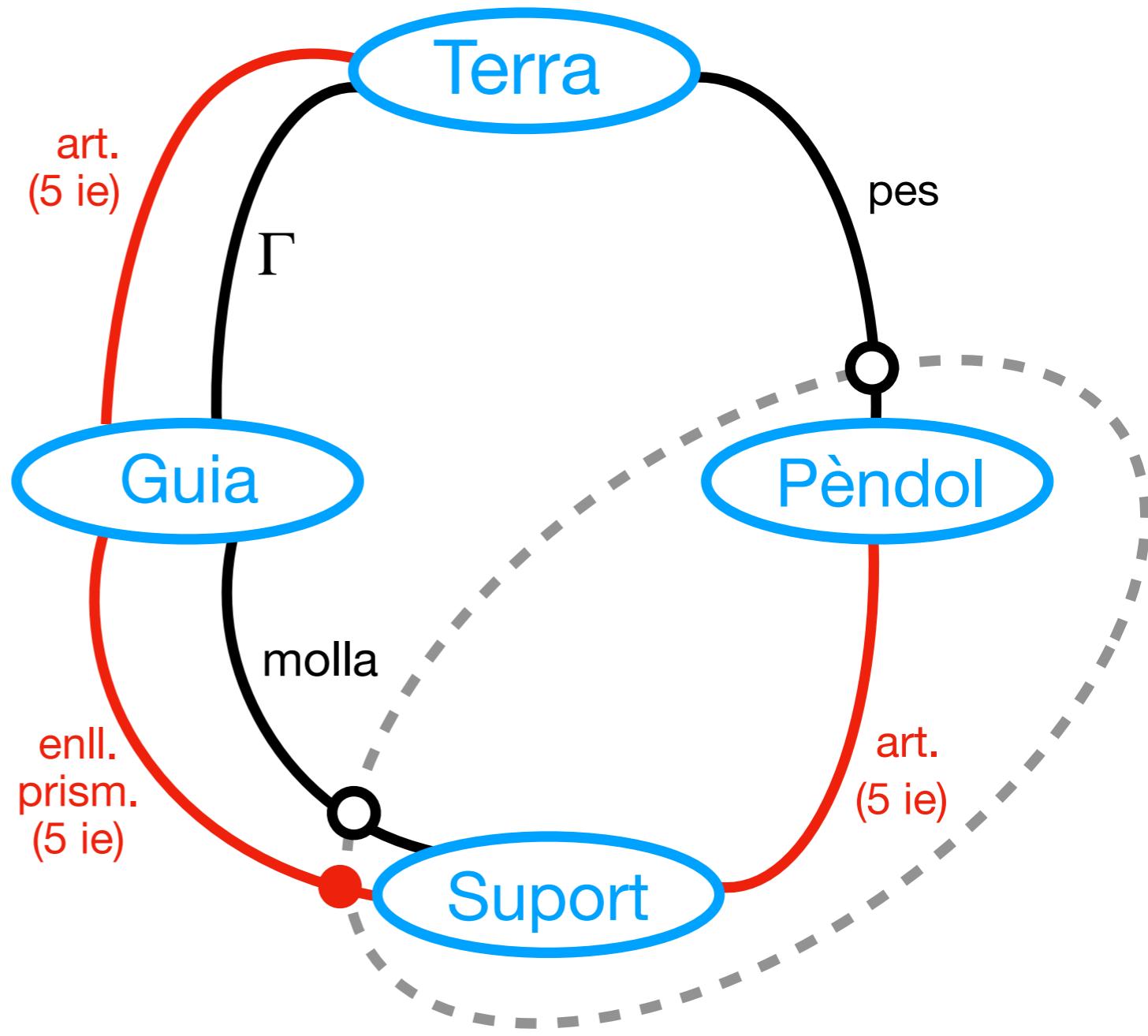
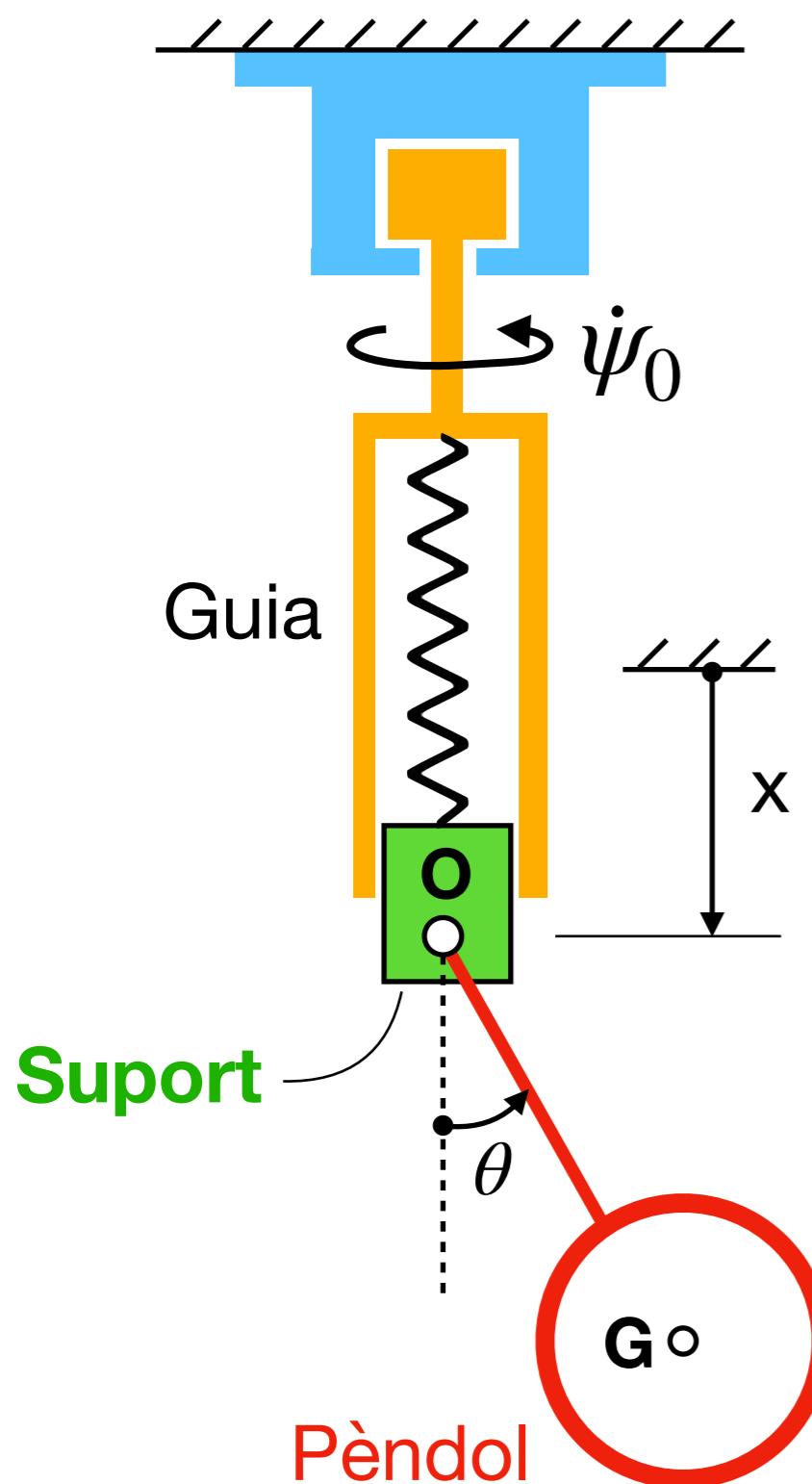
DGI



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

Explorem sistemes que els incloguin

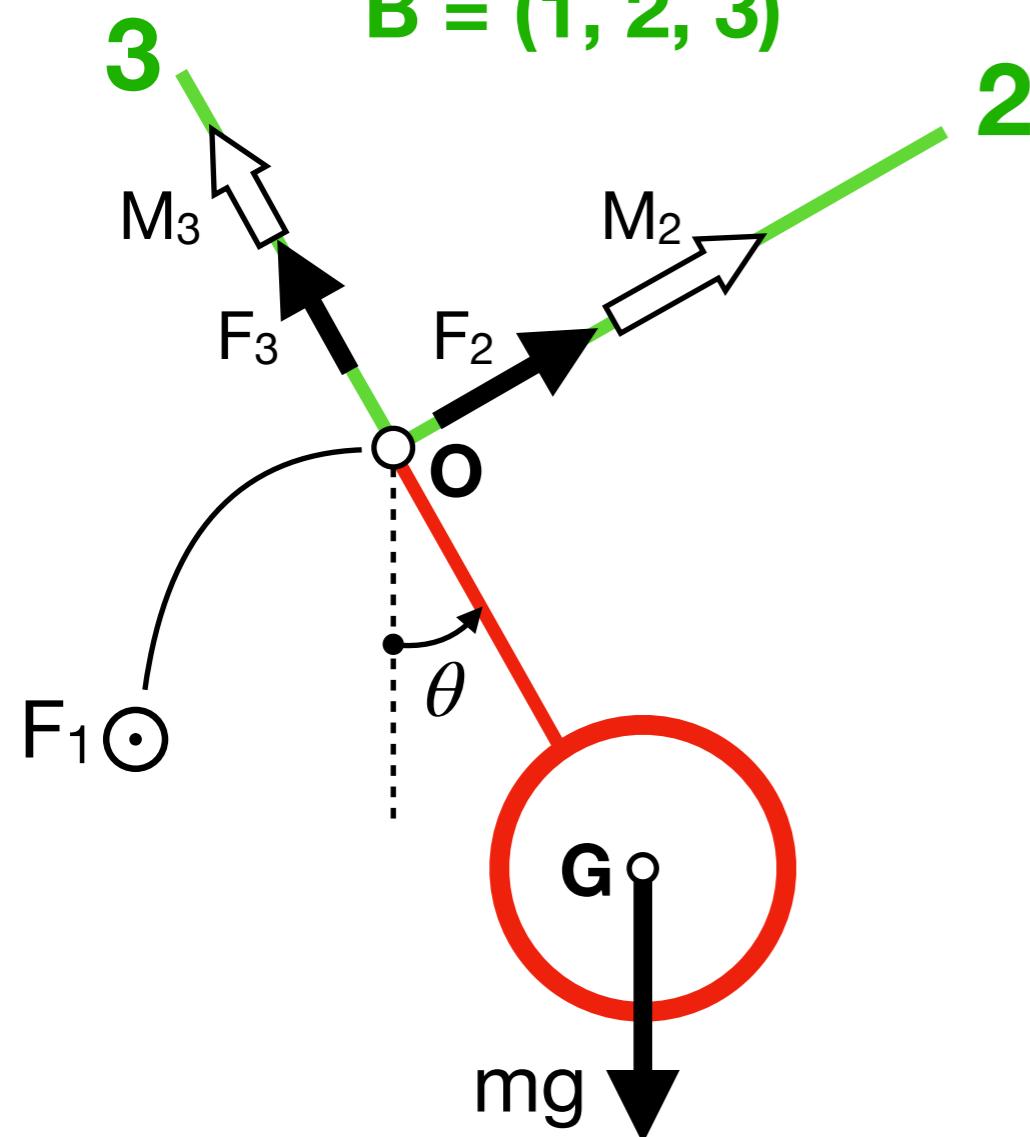




Sistema	Incògn.	Problema
Pèndol	$5\ ie, \ddot{x}, \ddot{\theta}$	INDET
Pènd. + sup.	$5\ ie, \ddot{x}, \ddot{\theta}$	INDET
Els altres sistemes tenen + incògnites !		

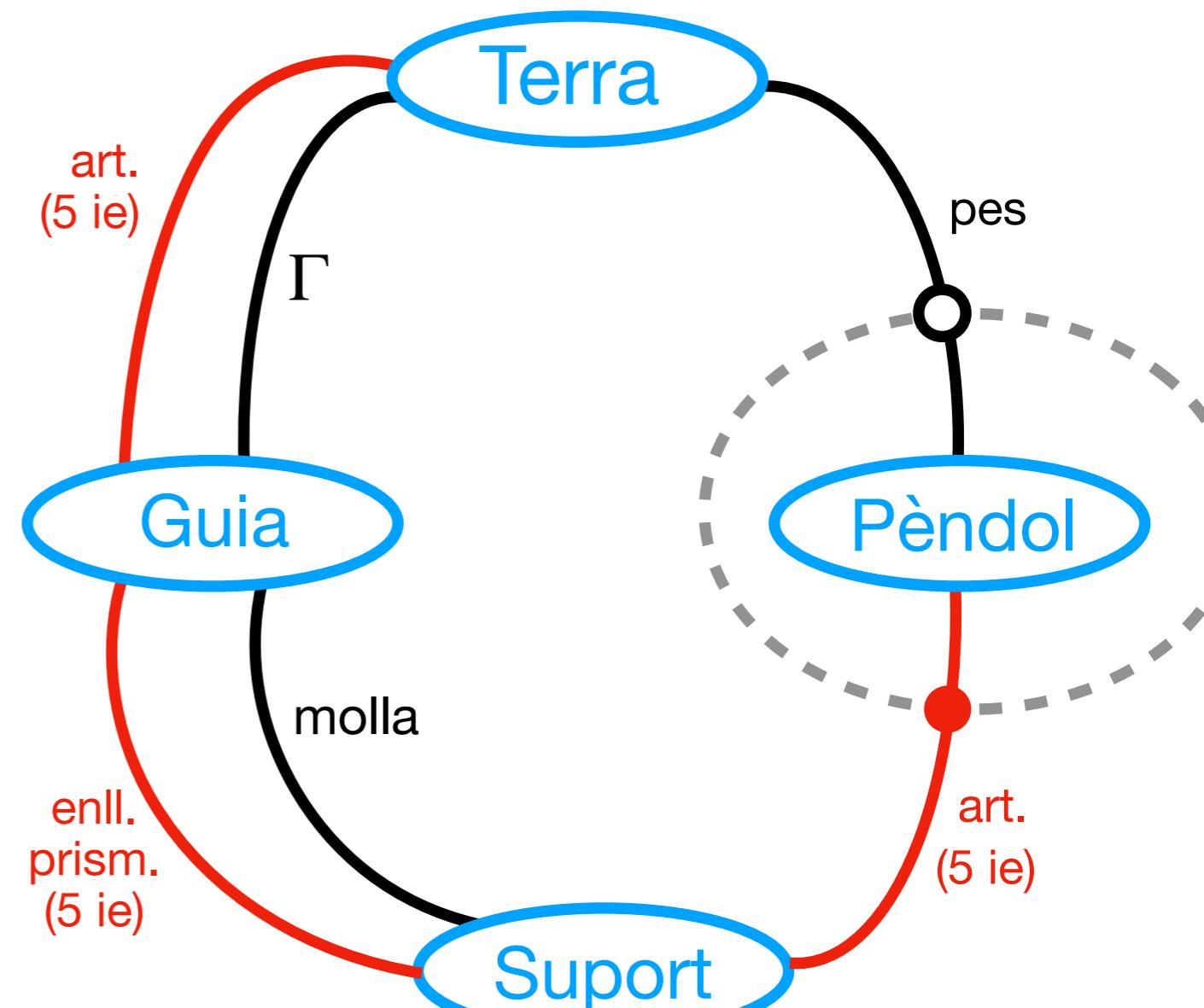
Sist = Pèndol

$$B = (1, 2, 3)$$

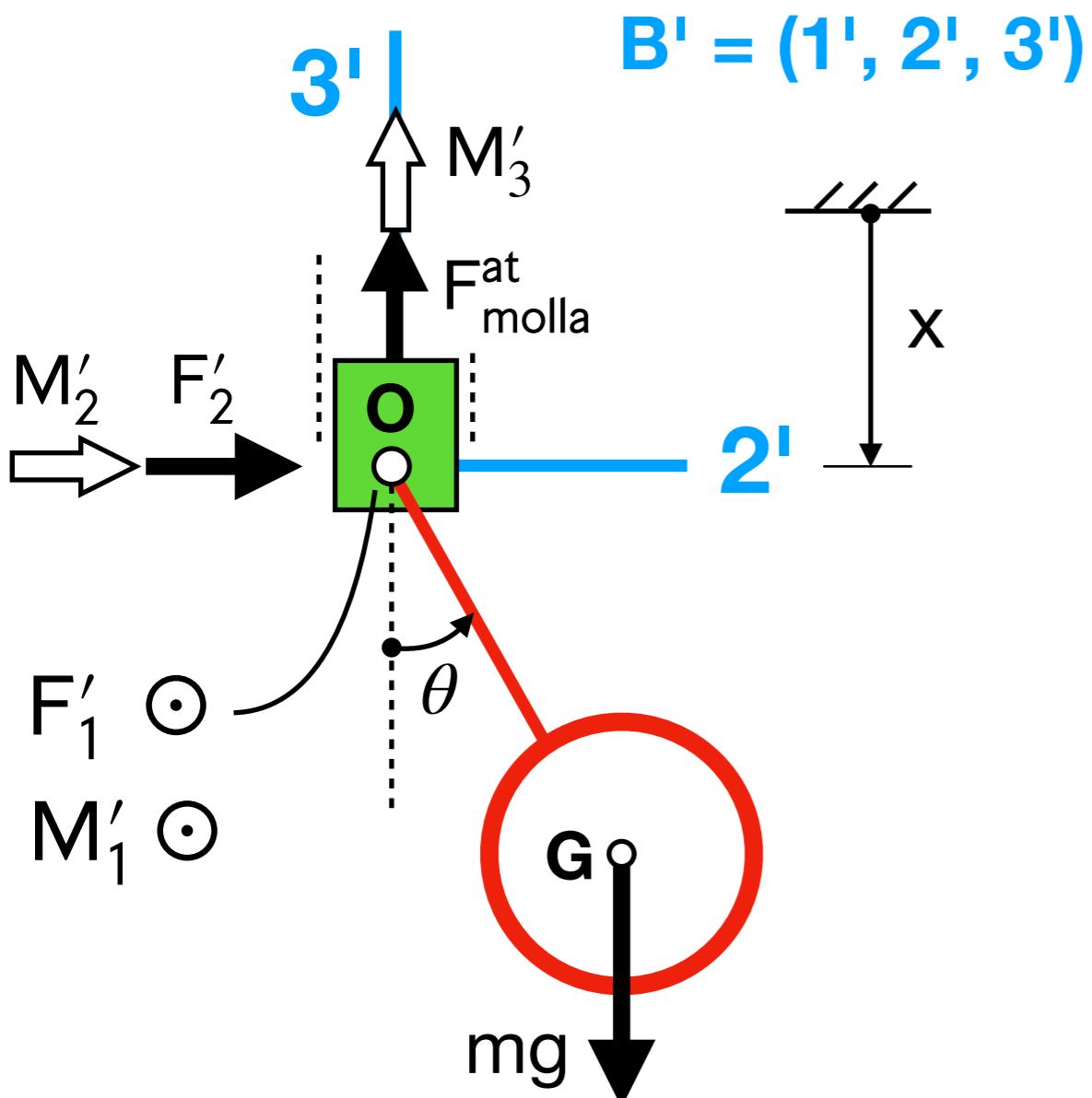


$$\left\{ \bar{F}_{\text{Sup} \rightarrow \text{Pendol}} \right\}_B = \left\{ \begin{array}{l} F_1 \\ F_2 \\ F_3 \end{array} \right\}$$

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



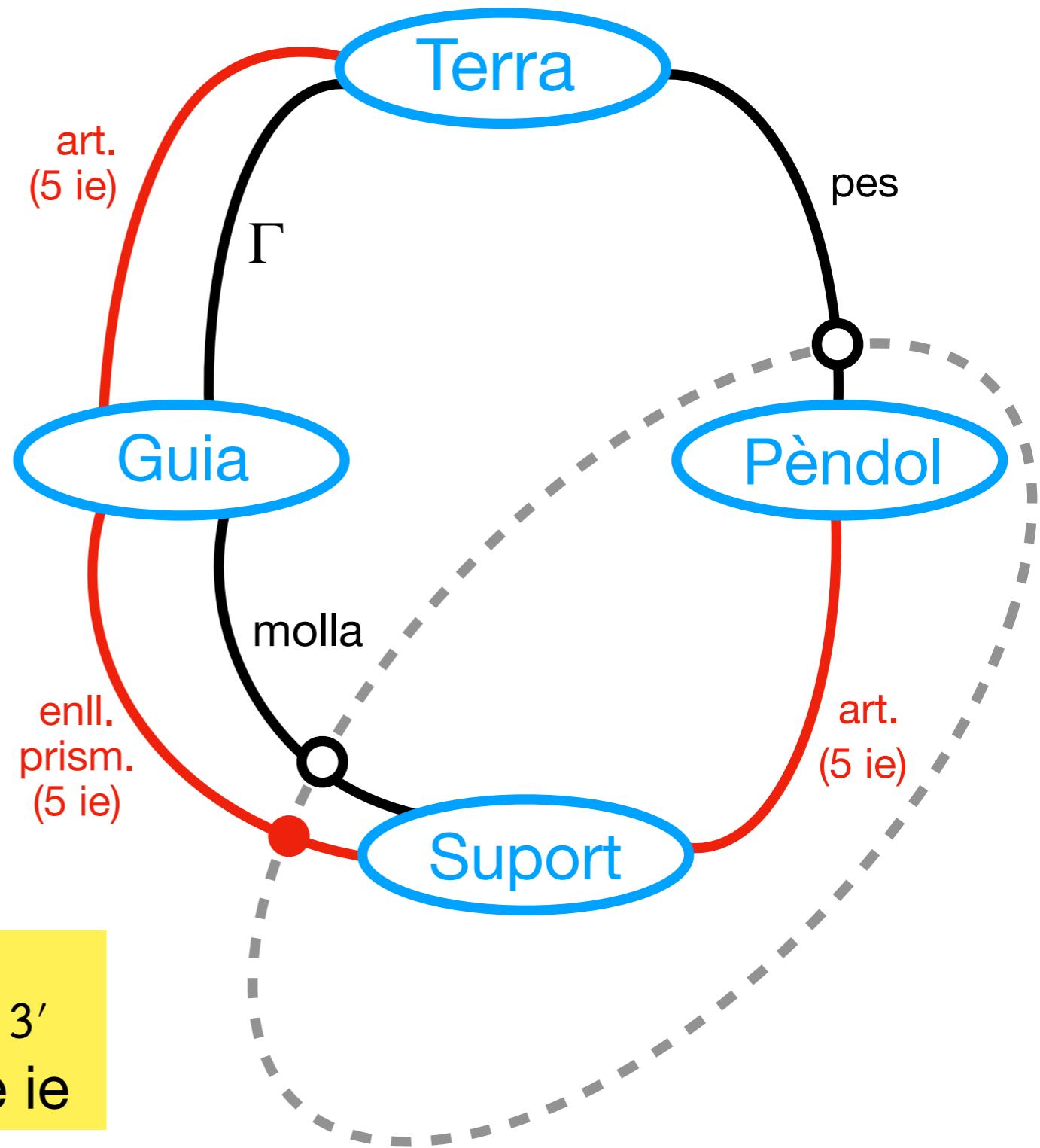
Sist = Pèndol + Suport



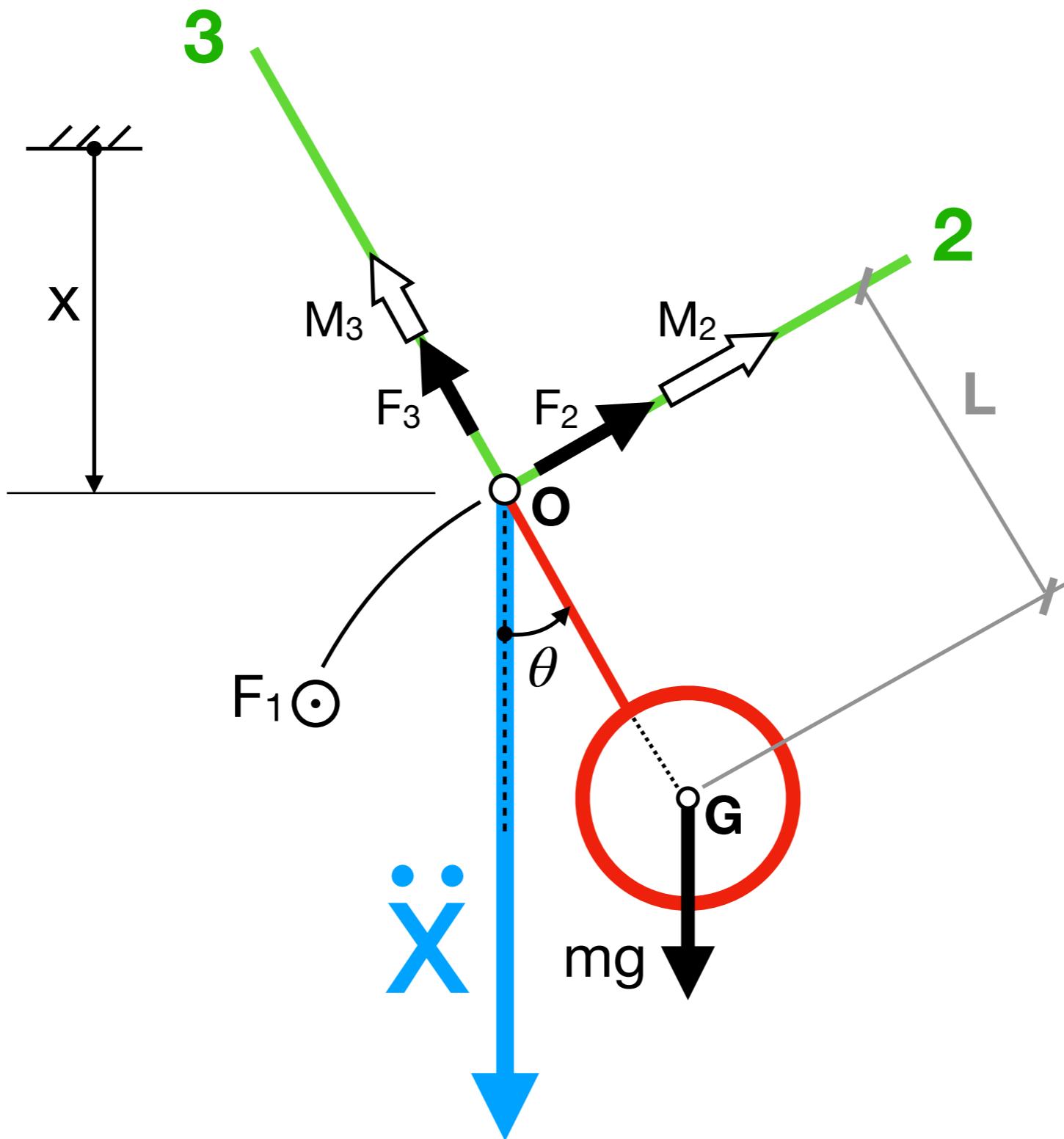
$$\left\{ \bar{F}_{Guia \rightarrow Sup} \right\}_{B'} = \begin{Bmatrix} F'_1 \\ F'_2 \\ 0 \end{Bmatrix}$$

TQM]_{3'}
Illiure de ie

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



TMC(O)]₁ sobre SIST = Pèndol



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

Pas final

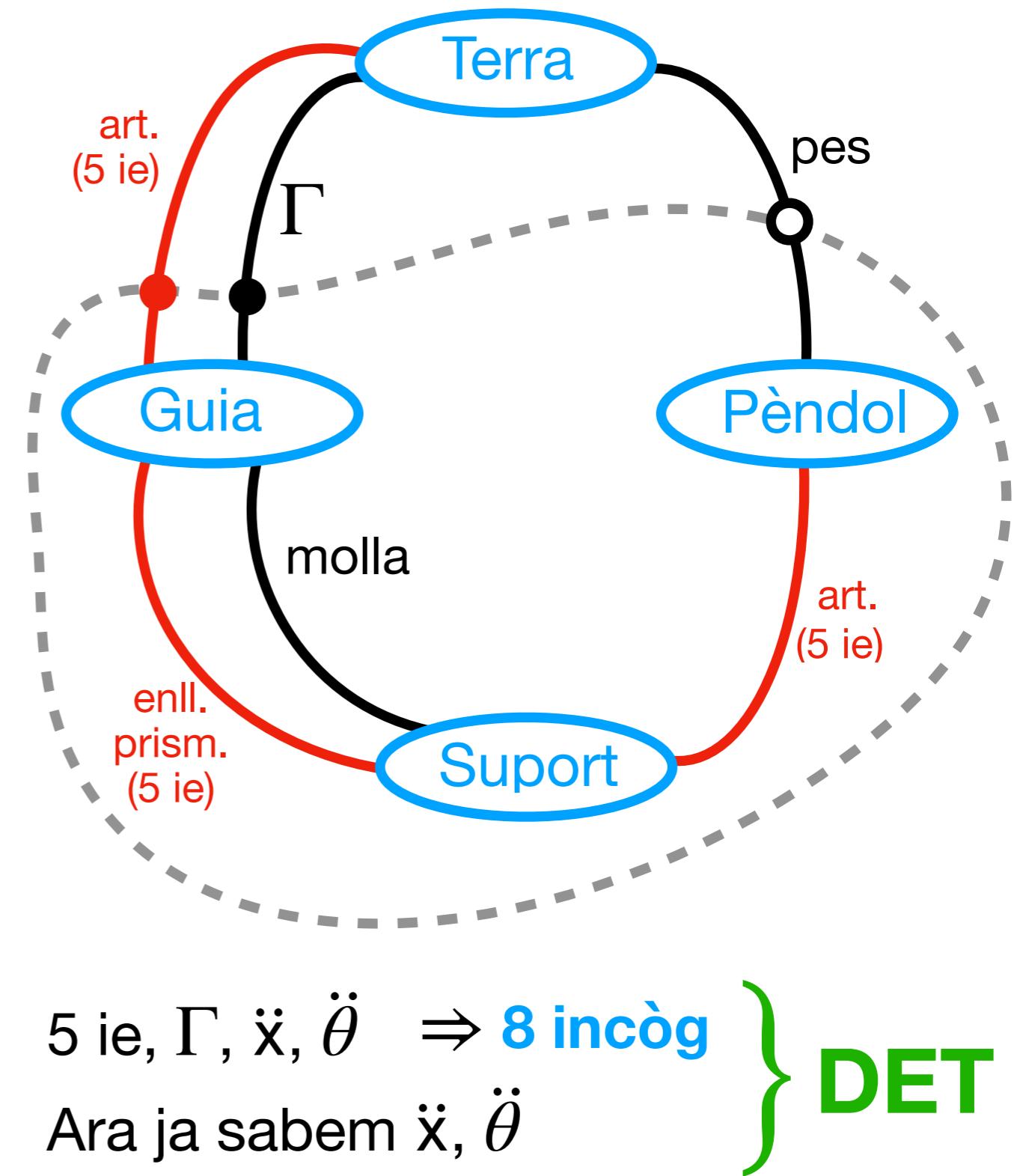
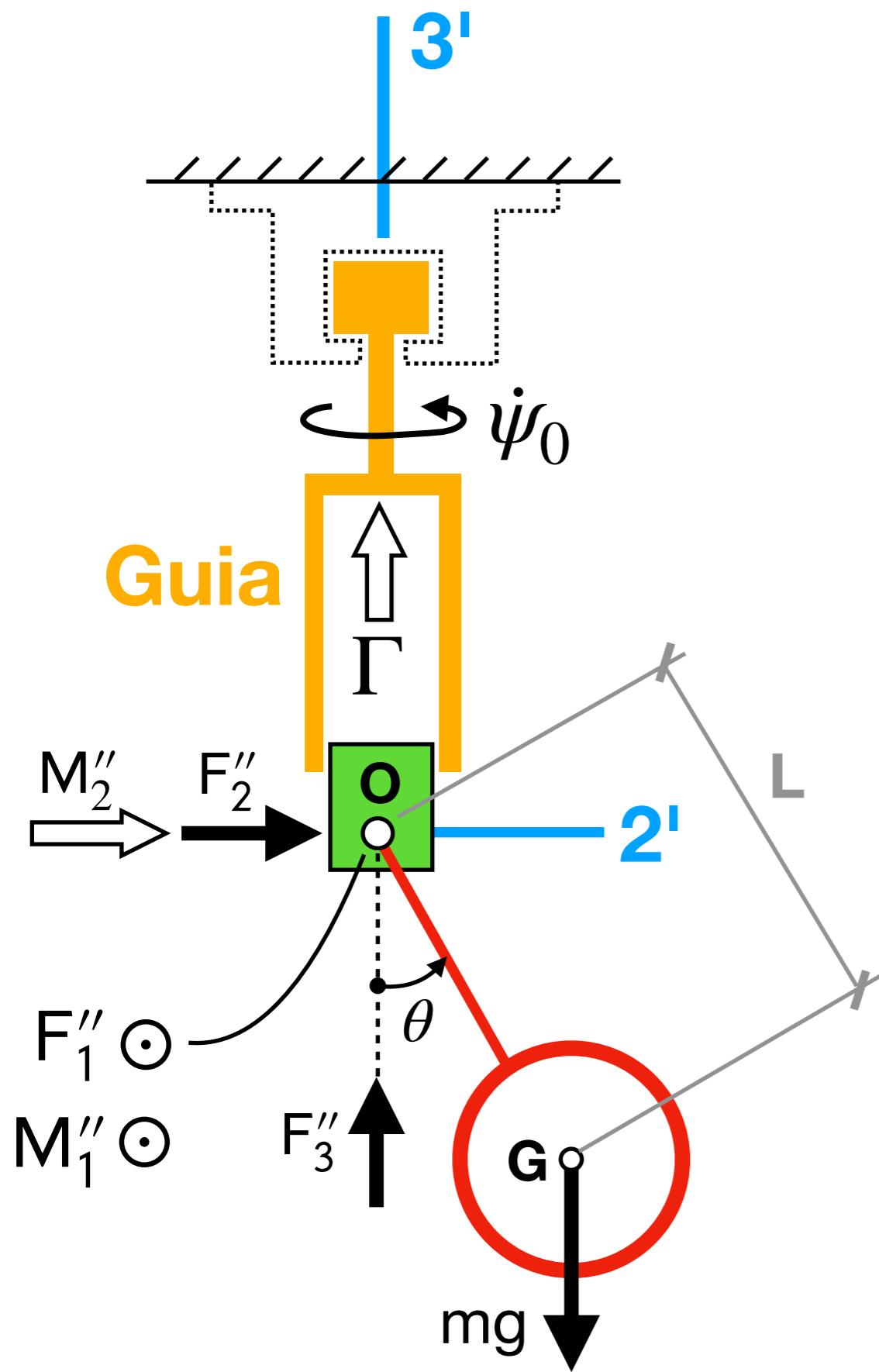
$$\left\{ \begin{array}{l} (R^2 + L^2) \ddot{\theta} - (L \sin \theta) \ddot{x} = (L \dot{\psi}_0^2 \cos \theta - g) L \sin \theta \\ - (L \sin \theta) \ddot{\theta} + \ddot{x} = - \frac{k}{m} x + L \dot{\theta}^2 \cos \theta \end{array} \right.$$

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

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

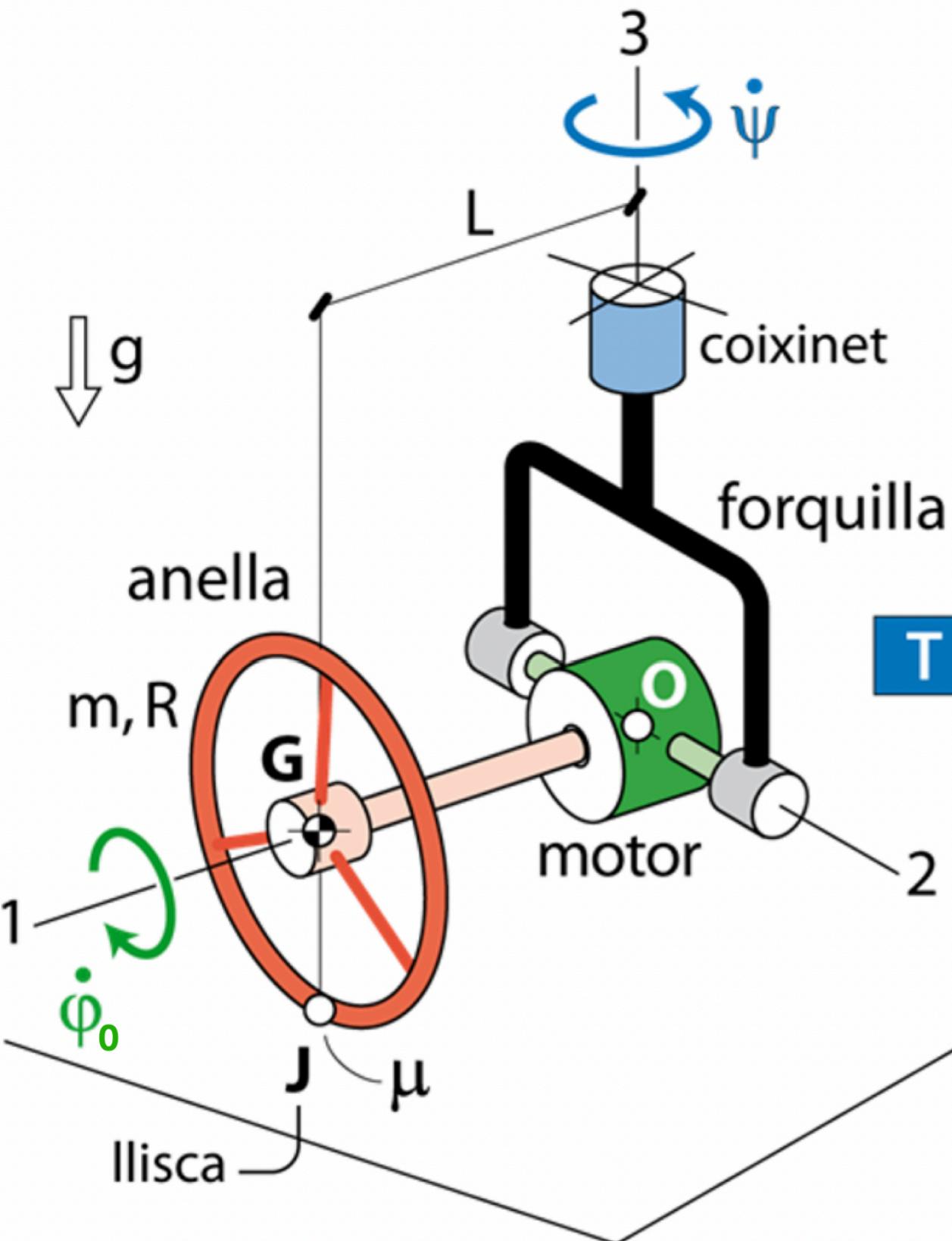
No cal
que el feu

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



D'abans

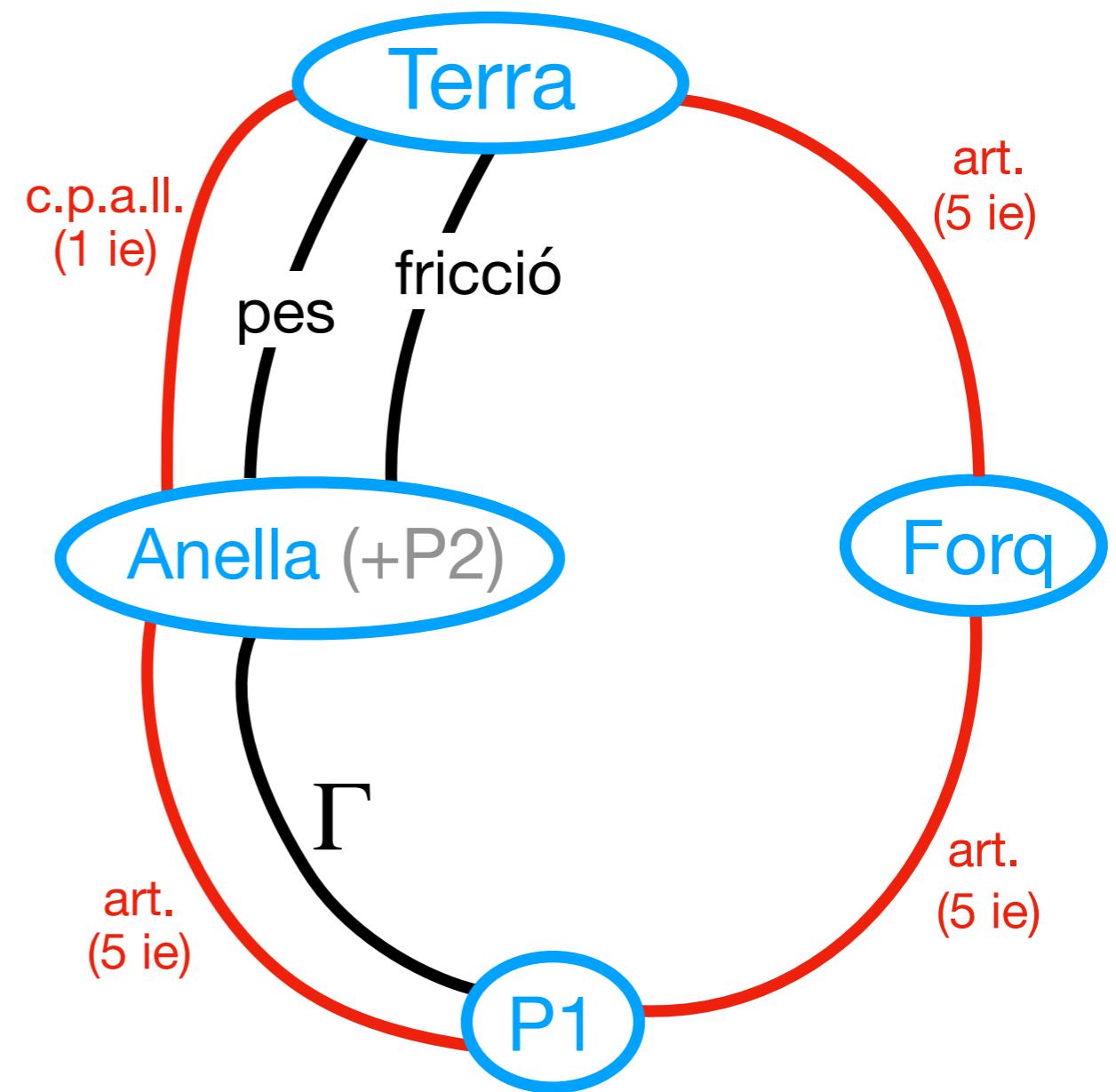
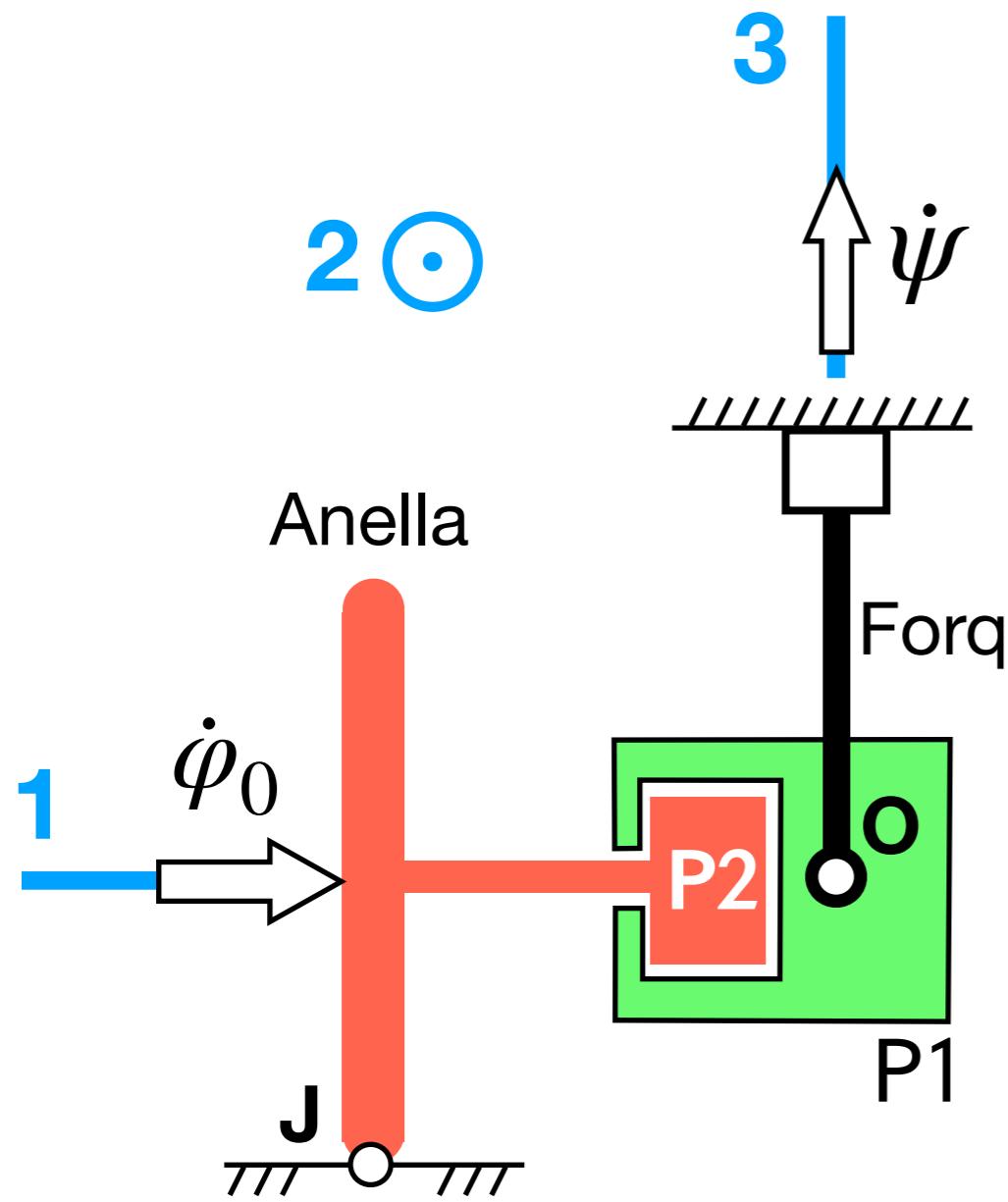
$$\left\{ \dot{\bar{H}}_{RTO}(\mathbf{O}) \right\}_B = \begin{Bmatrix} I_{11} \ddot{\theta} + (I_{33} - I_{22}) \dot{\psi}_0^2 \sin \theta \cos \theta \\ (I_{11} + I_{22} - I_{33}) \dot{\psi}_0 \dot{\theta} \cos \theta \\ (I_{22} - I_{11} - I_{33}) \dot{\psi}_0 \dot{\theta} \sin \theta \end{Bmatrix}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



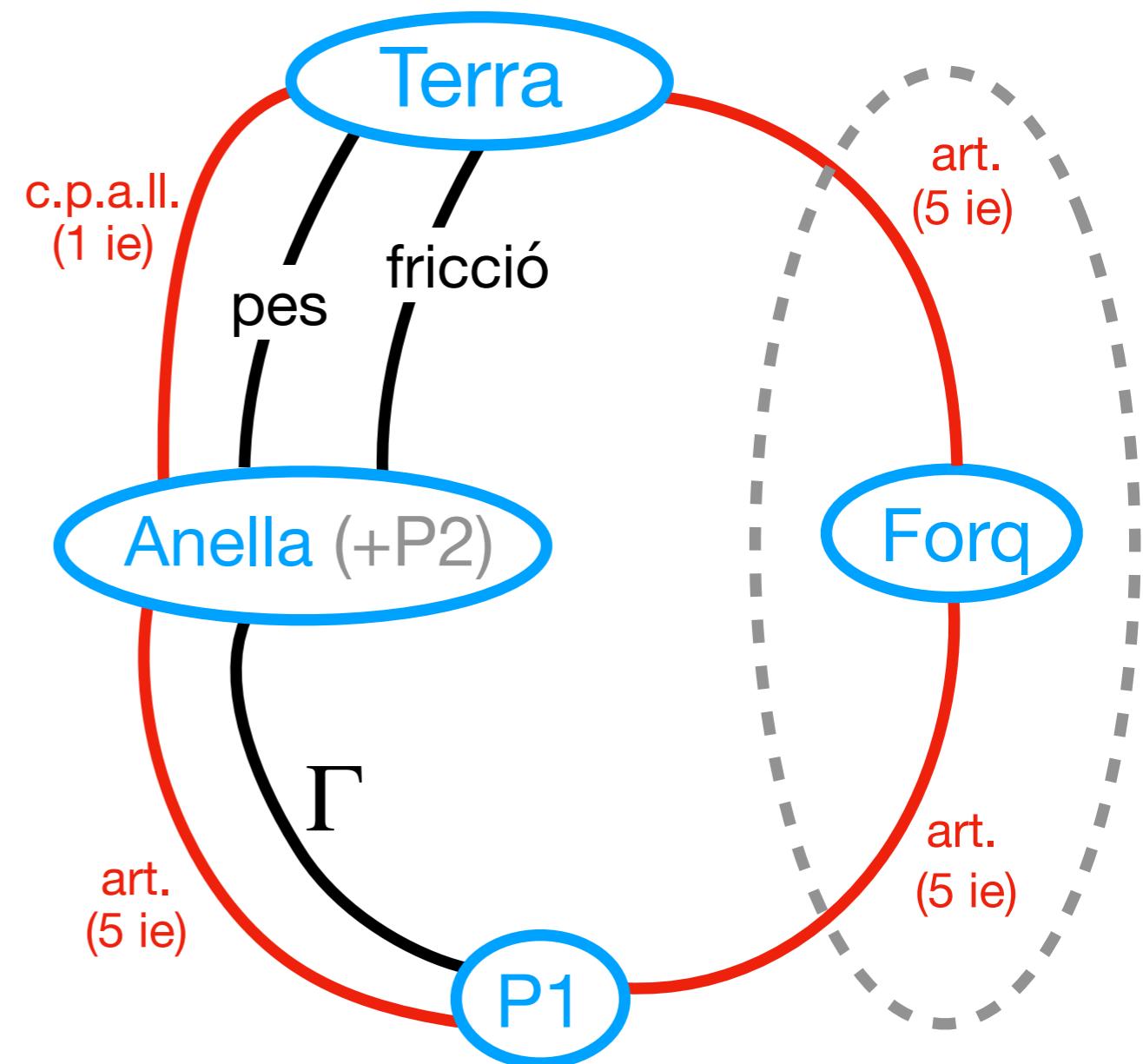
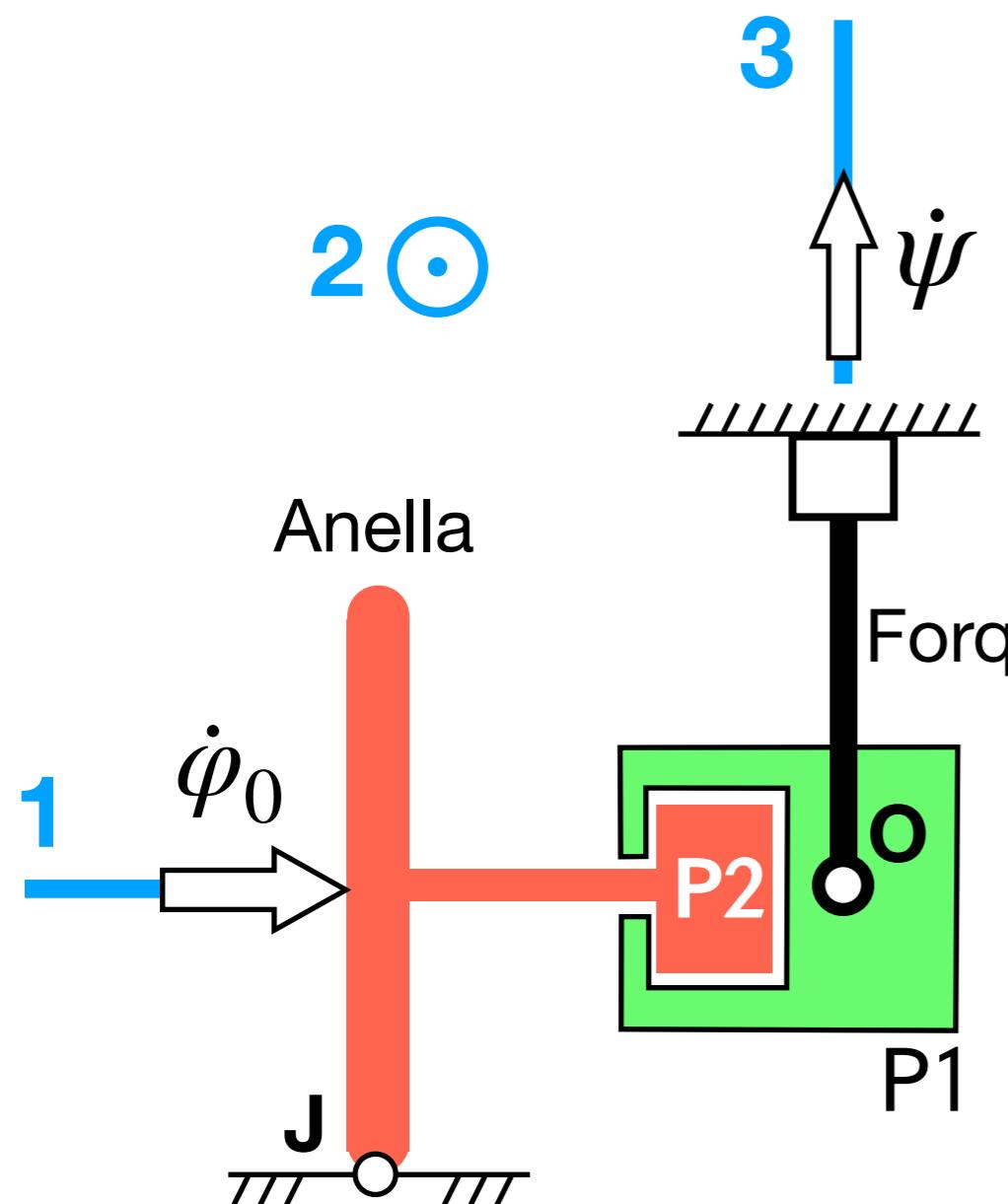
- GL sistema?
- DGI
- Caracterització de torsors?
- Eq. mov per a la coord. ψ
- Força normal a J
- Parell motor per mantenir $\dot{\phi}_0$

Manté contacte puntual a J

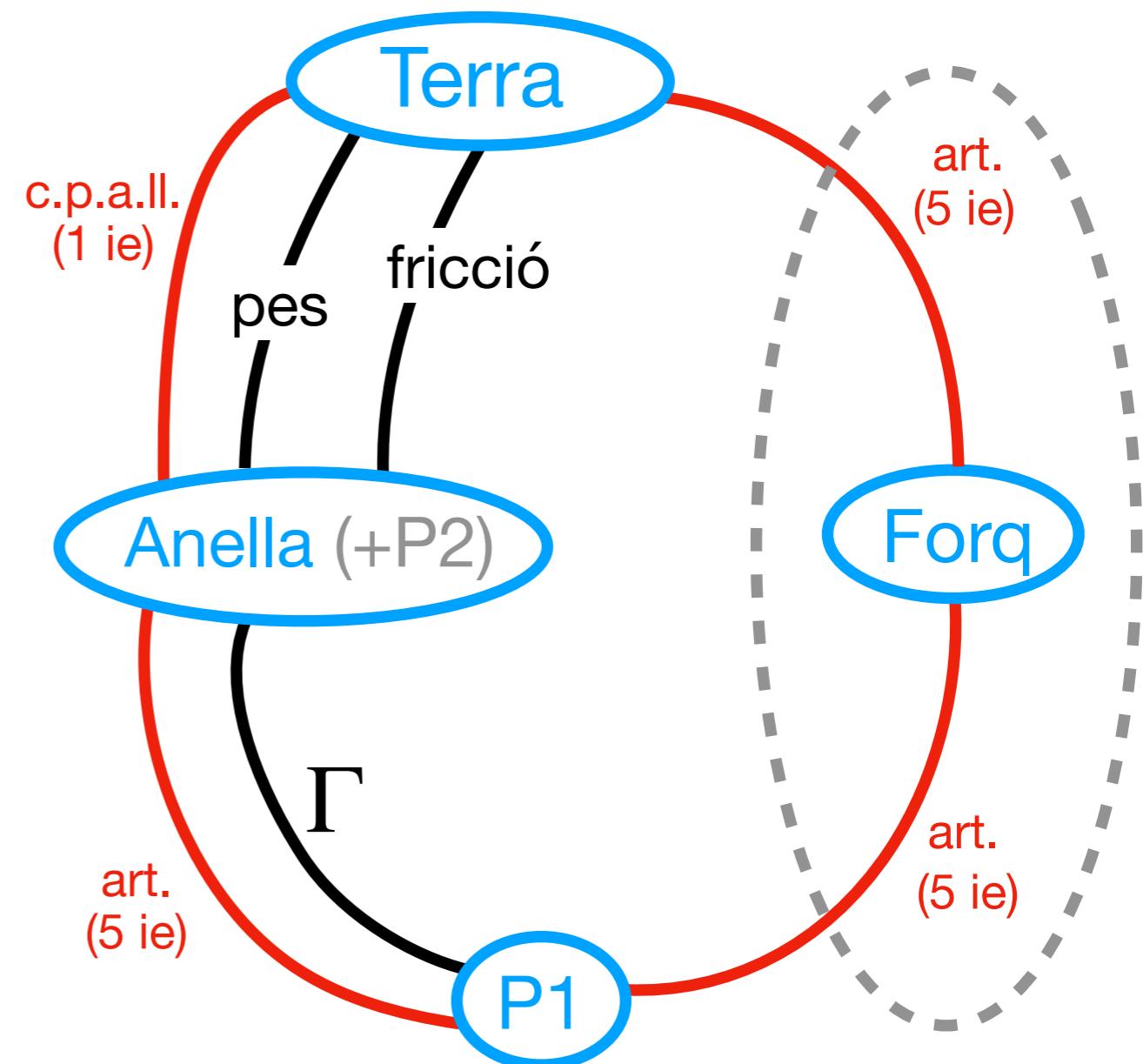
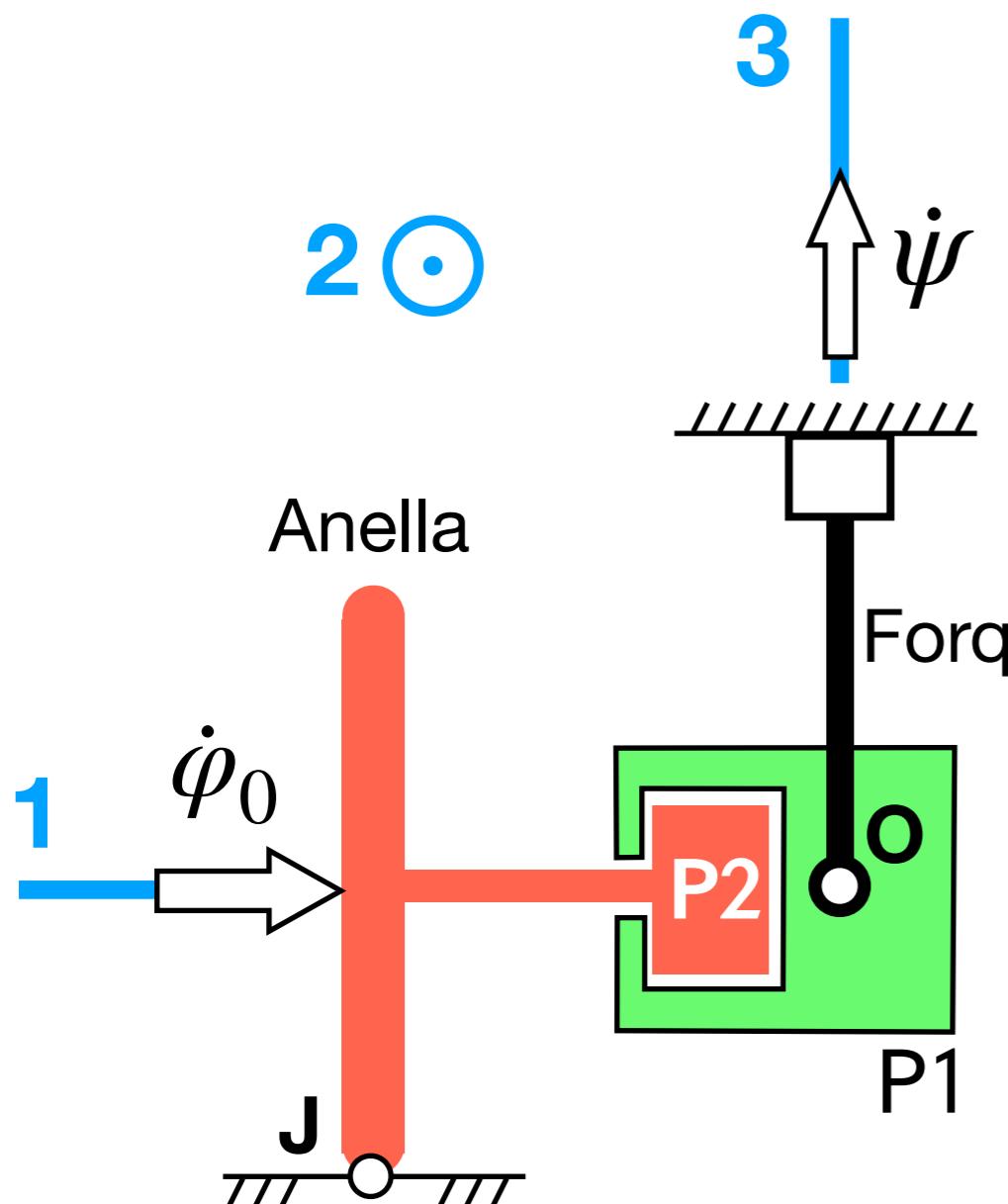
Motor manté $\dot{\phi}_0 = \text{ct}$



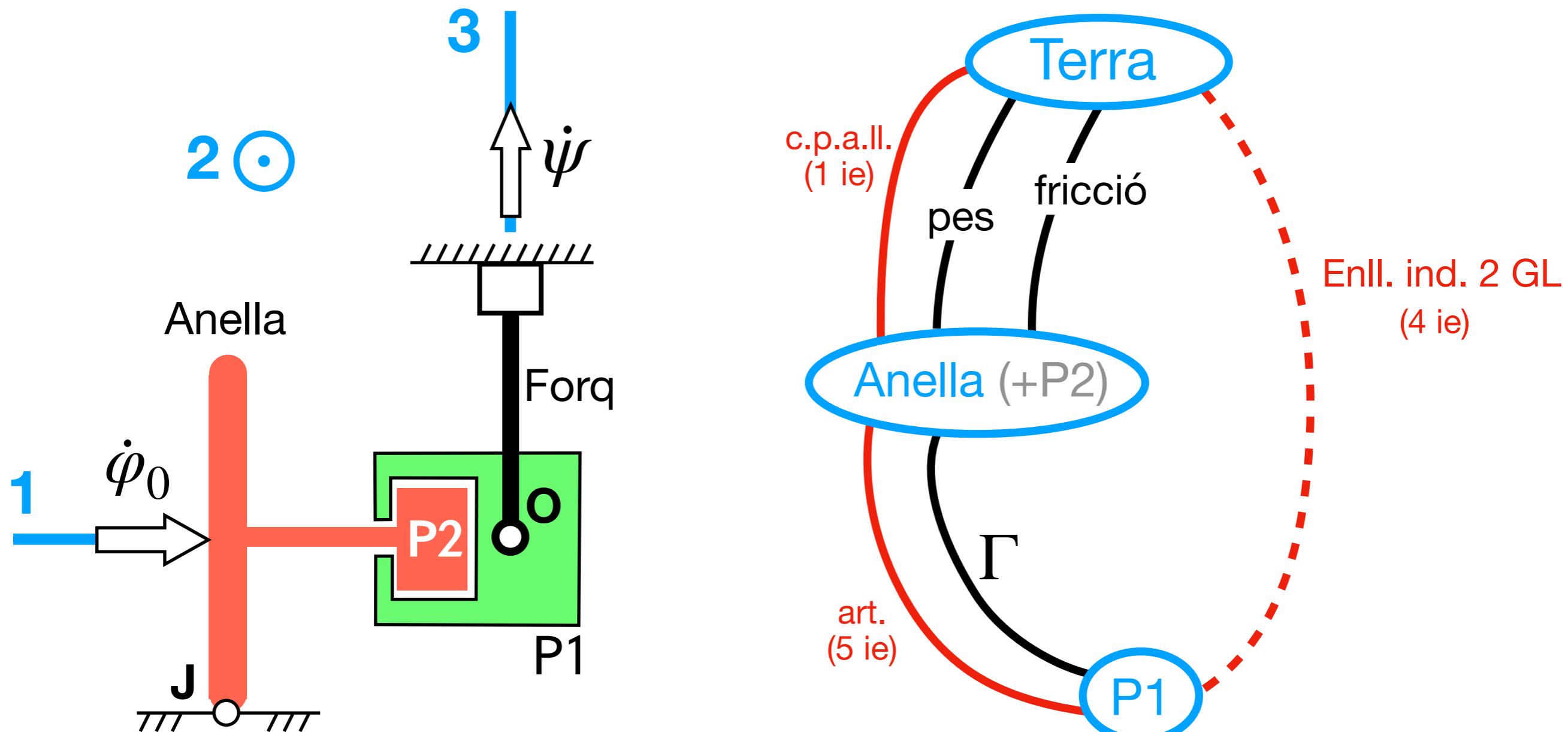
Forq és SAE ...



Substituim Forq per enllaç indirecte $T \rightarrow P_1$



Substituim Forq per enllaç indirecte $T \rightarrow P_1$

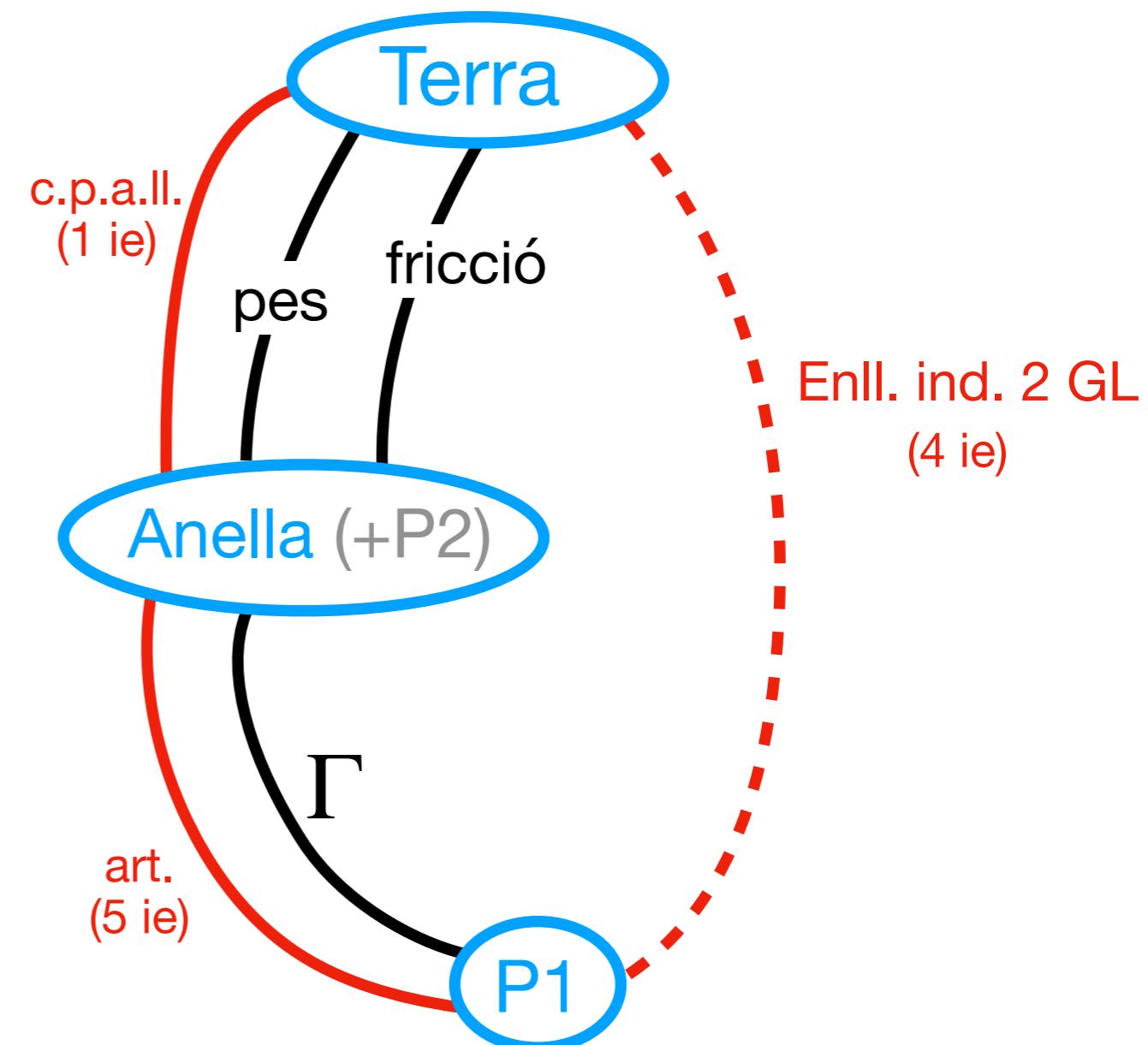
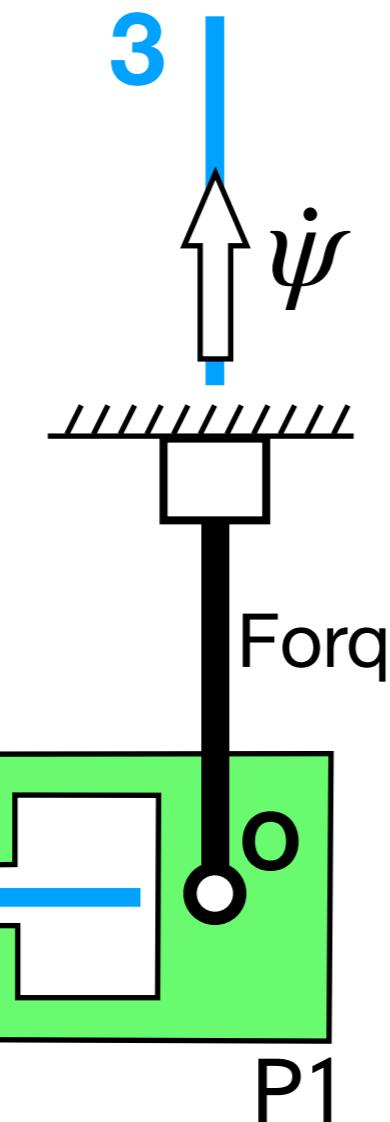


Substituim Forq per enllaç indirecte $T \rightarrow P_1$

$$B = (1, 2, 3)$$

2 \odot

1



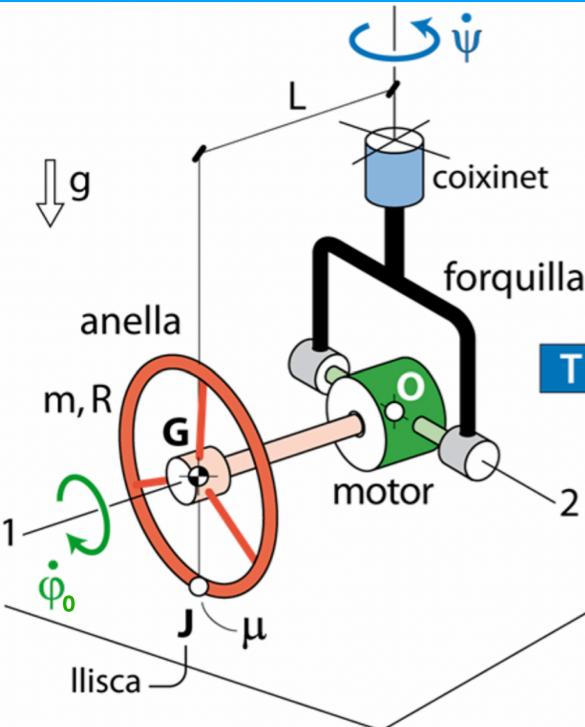
Torsor d'enllaç indirecte $T \rightarrow P_1$ al punt O:

$$\left\{ \bar{F}_{T \rightarrow (\text{forq}) \rightarrow P_1} \right\}_B = \begin{Bmatrix} F_1 \\ F_2 \\ F_3 \end{Bmatrix} \quad O \text{ fix a } T$$

$$\left\{ \bar{M}_{T \rightarrow (\text{forq}) \rightarrow P_1}(O) \right\}_B = \begin{Bmatrix} M_1 \\ 0 \\ 0 \end{Bmatrix}$$

0 en les rotacions
permeses de P1
resp T

Full ruta per eq. del mov. ψ

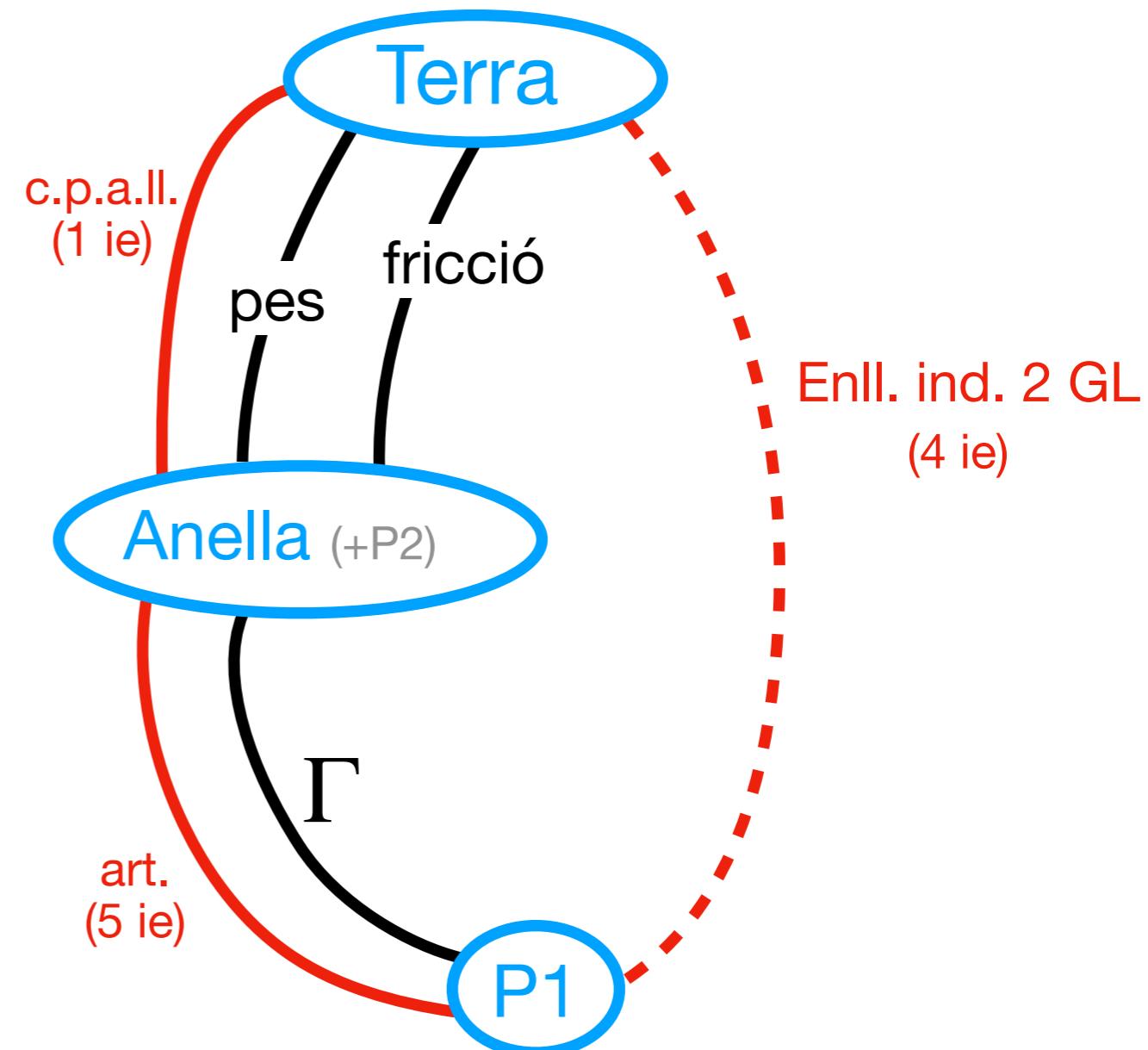


ψ afecta la cinemàtica de **P1** i **Anella**



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