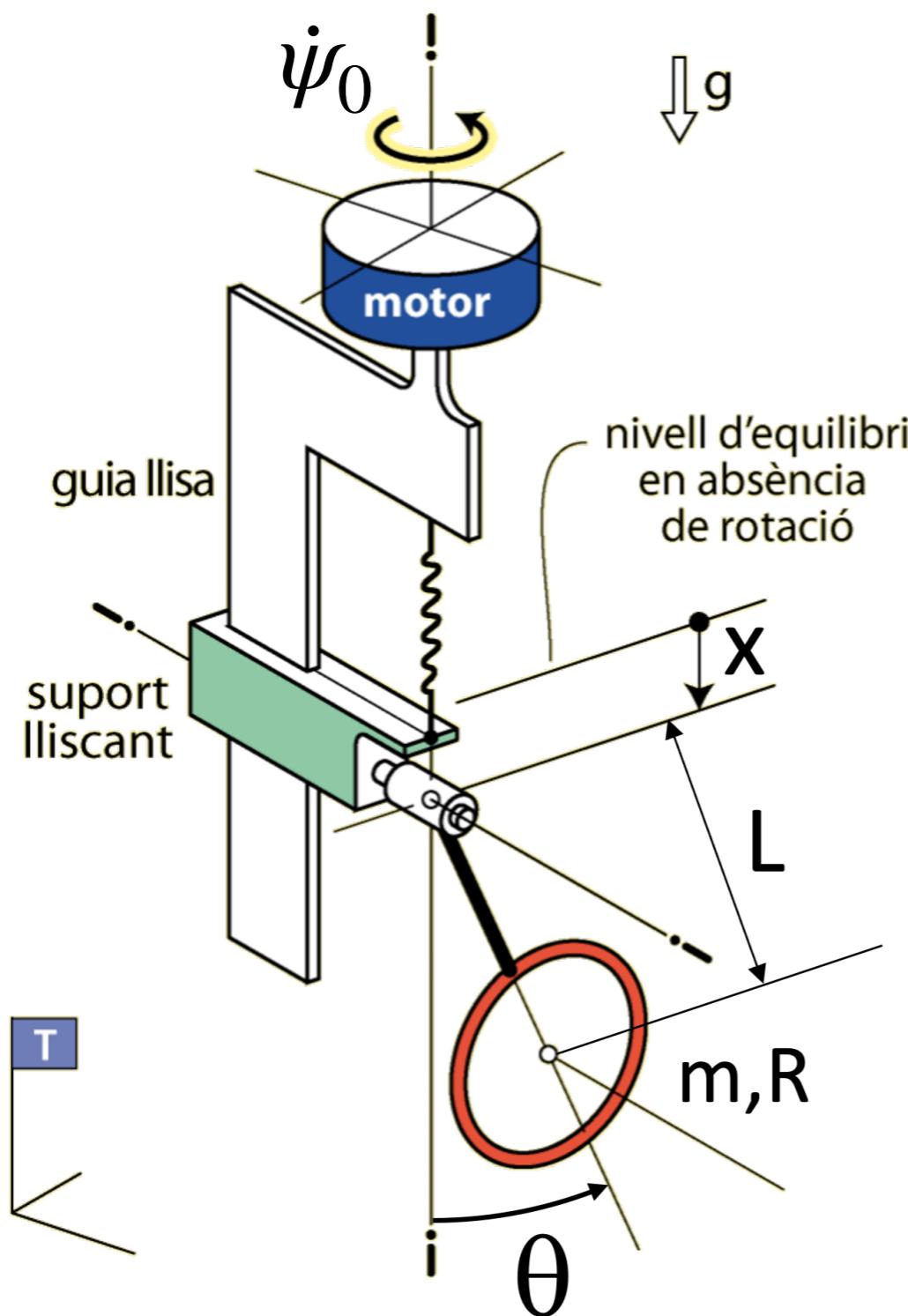


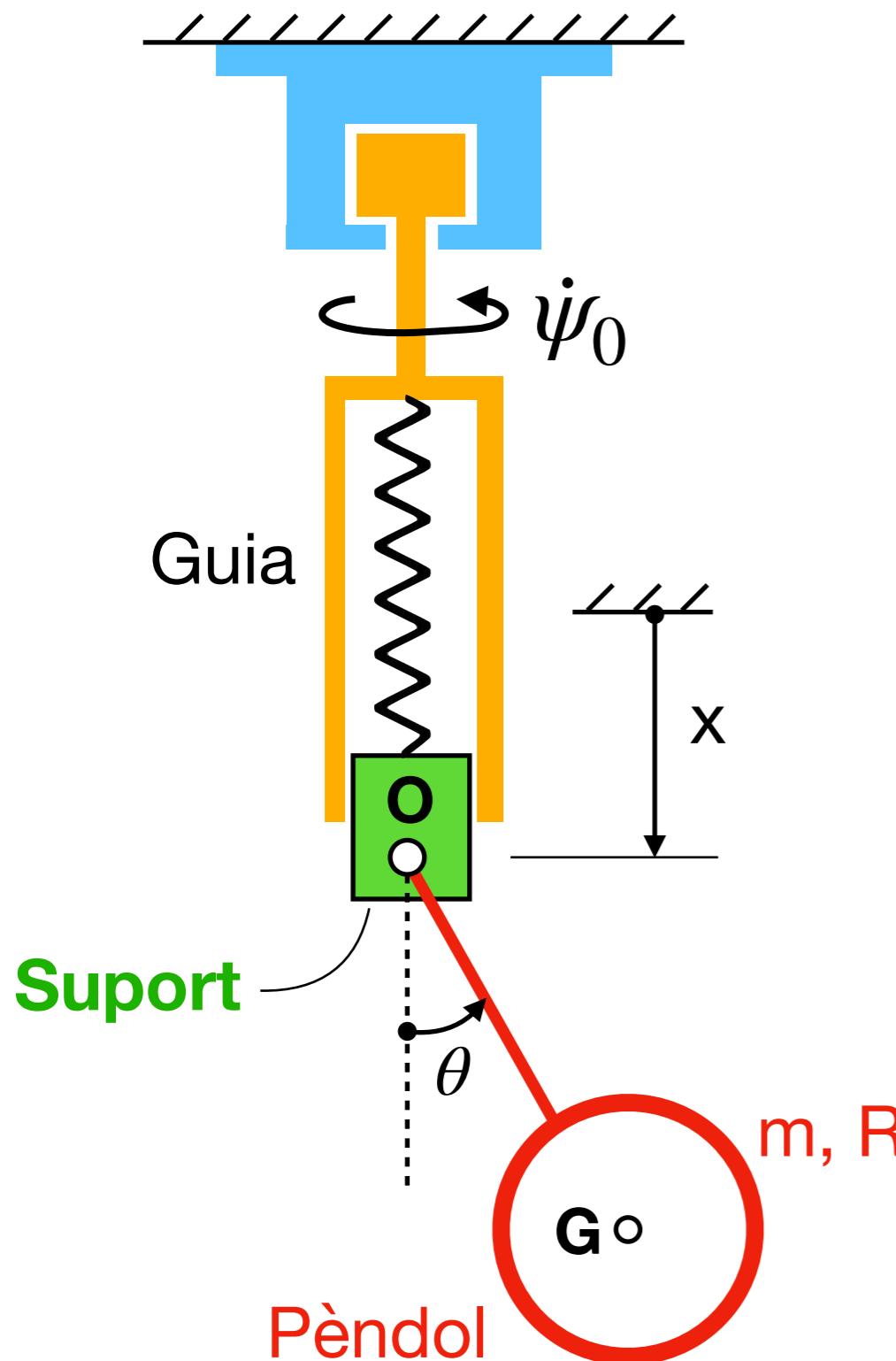
13P

Teoremes vectorials III

Exemples 3D

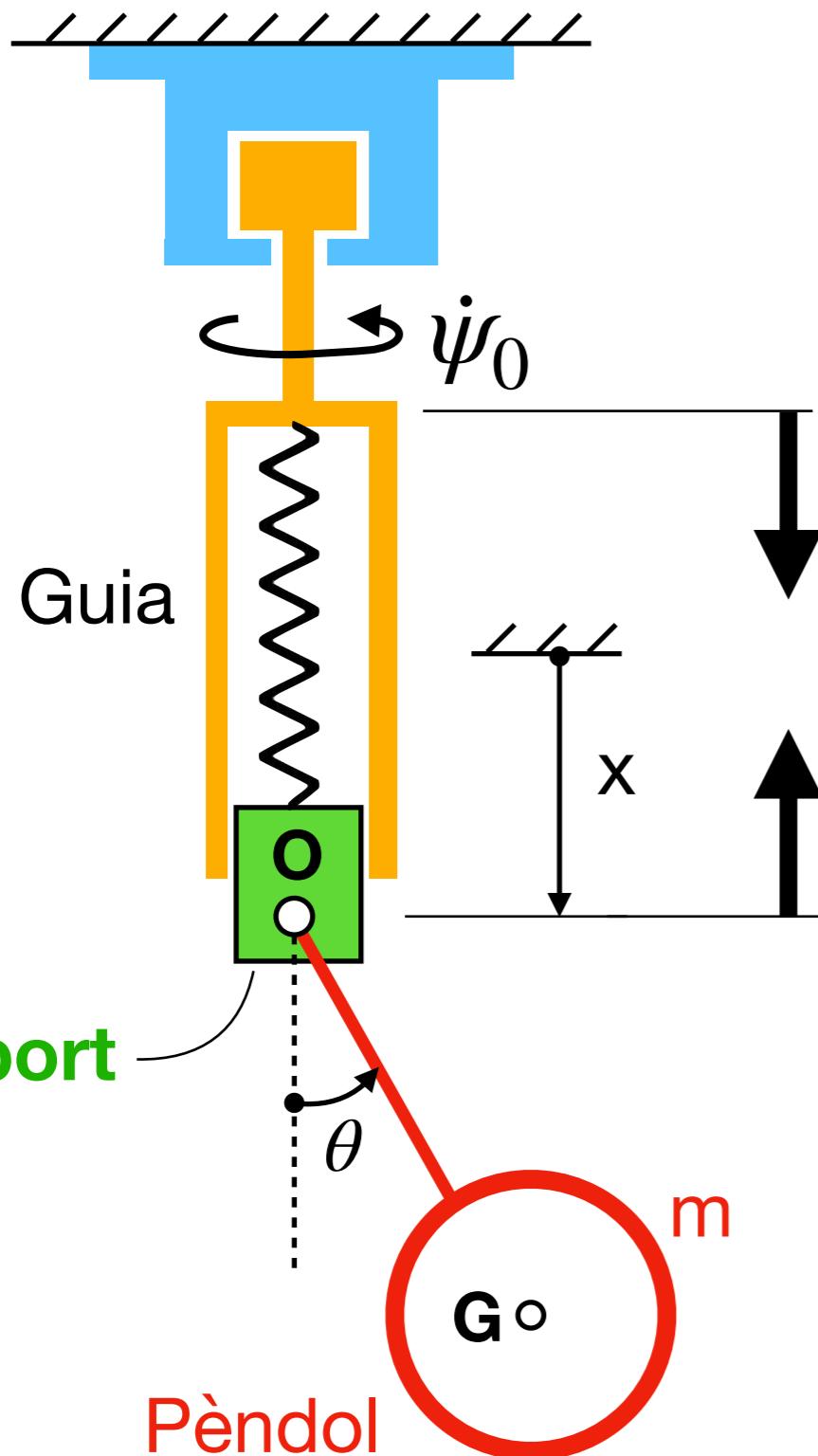


- DGI
- Eqs. mov. per a x i θ
- Parell motor Γ per mantenir $\dot{\psi}_0$



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

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

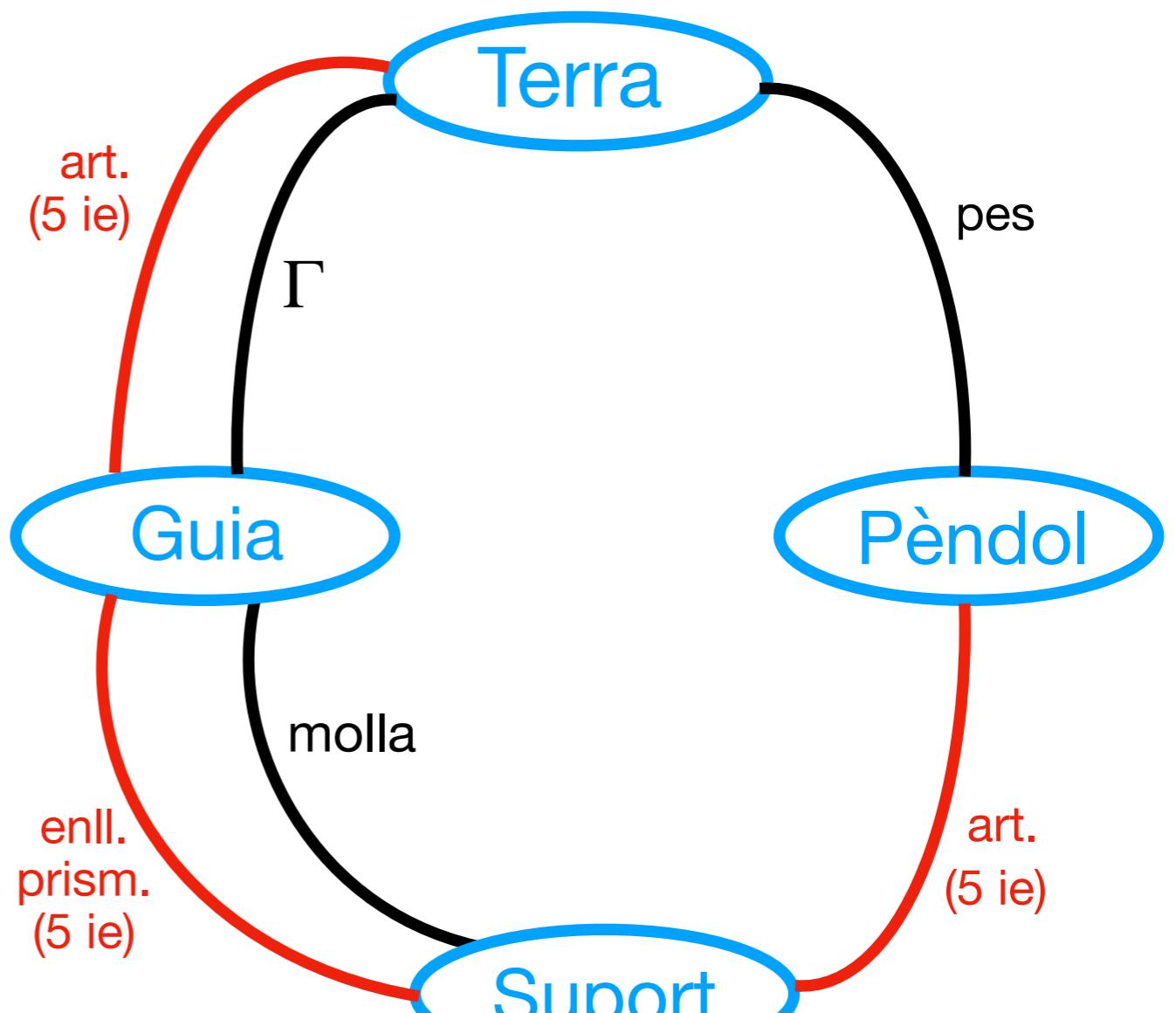
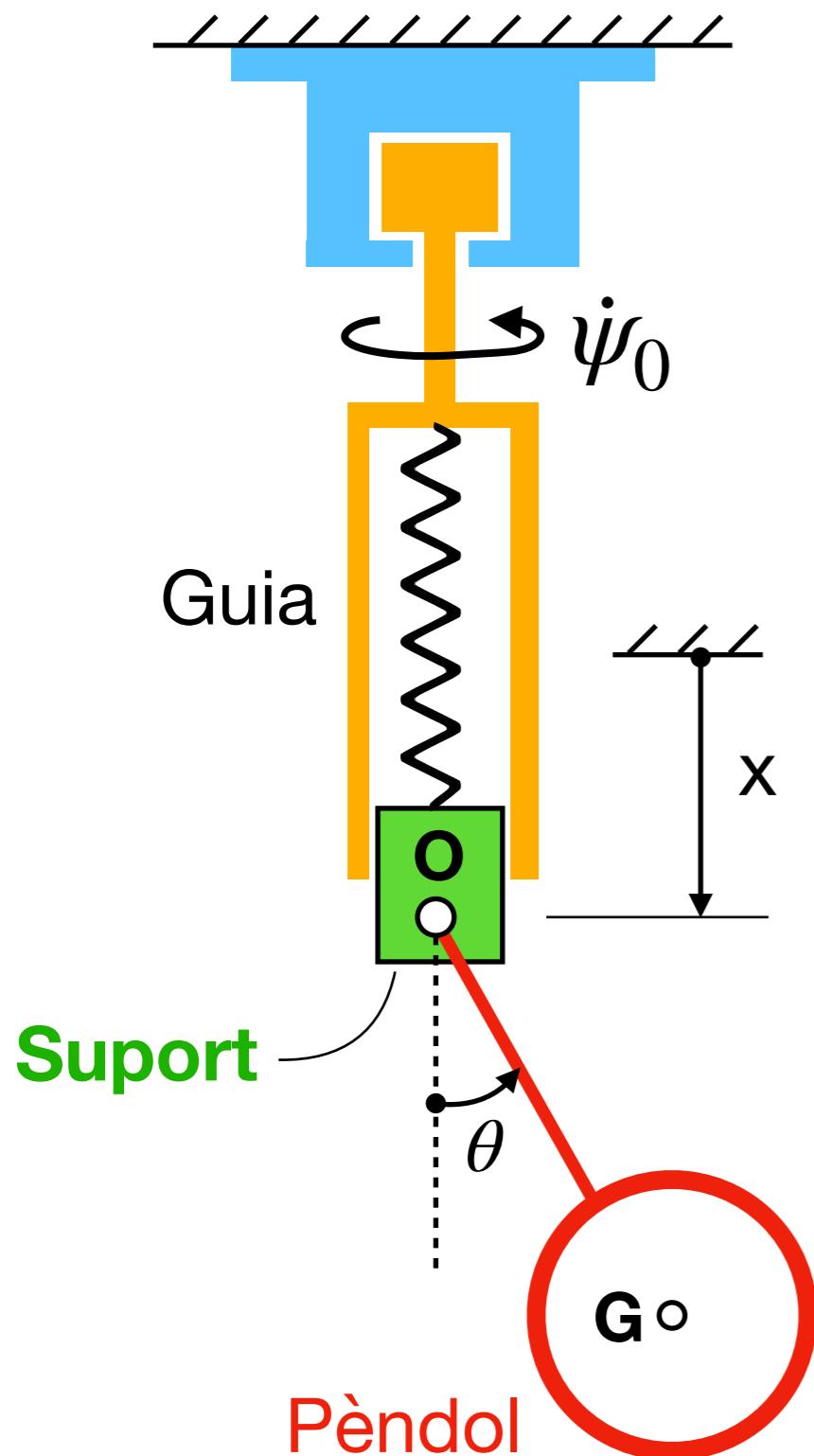


Força de la molla ?

$$F_{at\text{ molla}} = mg + kx$$

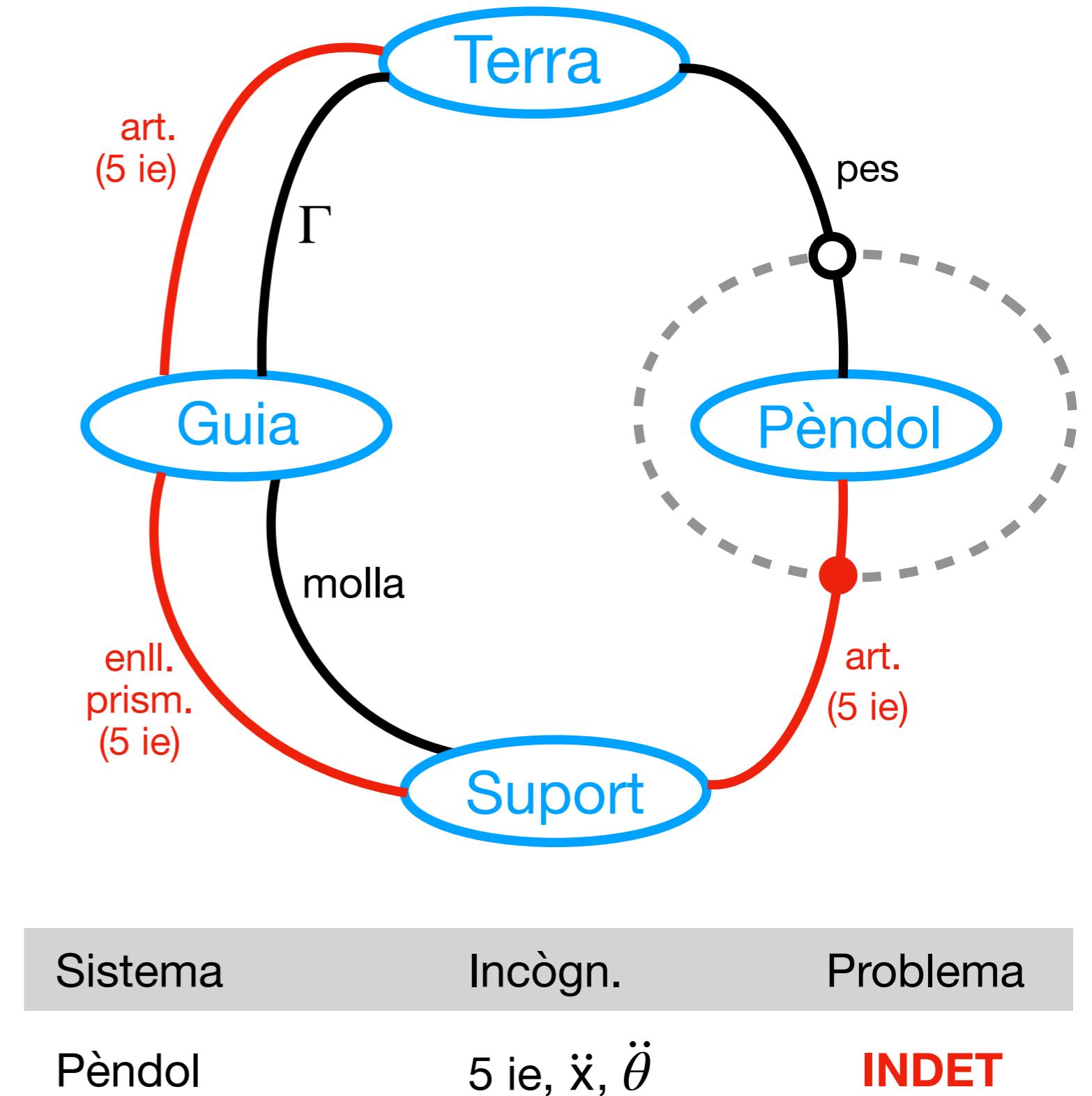
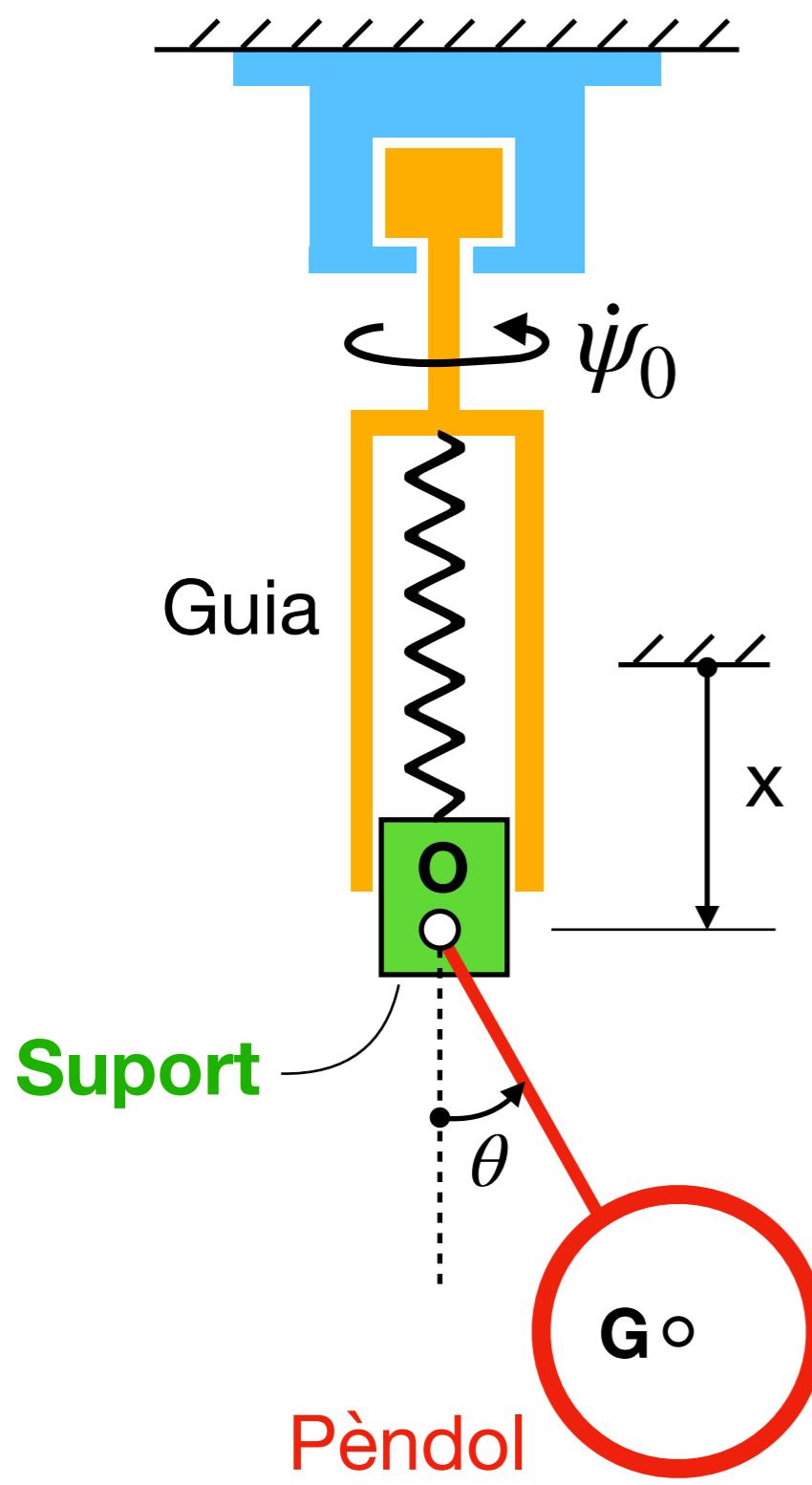
Suport

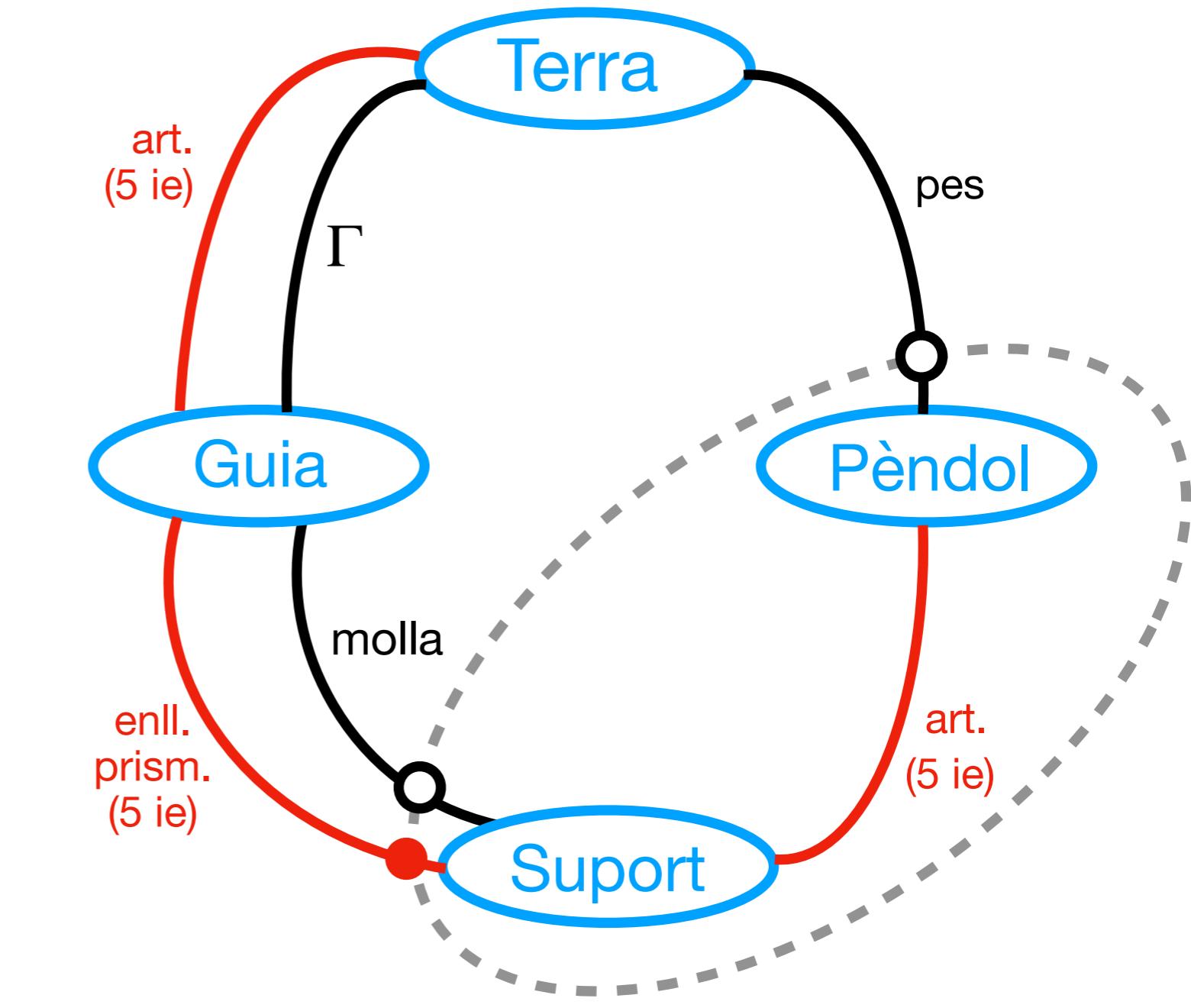
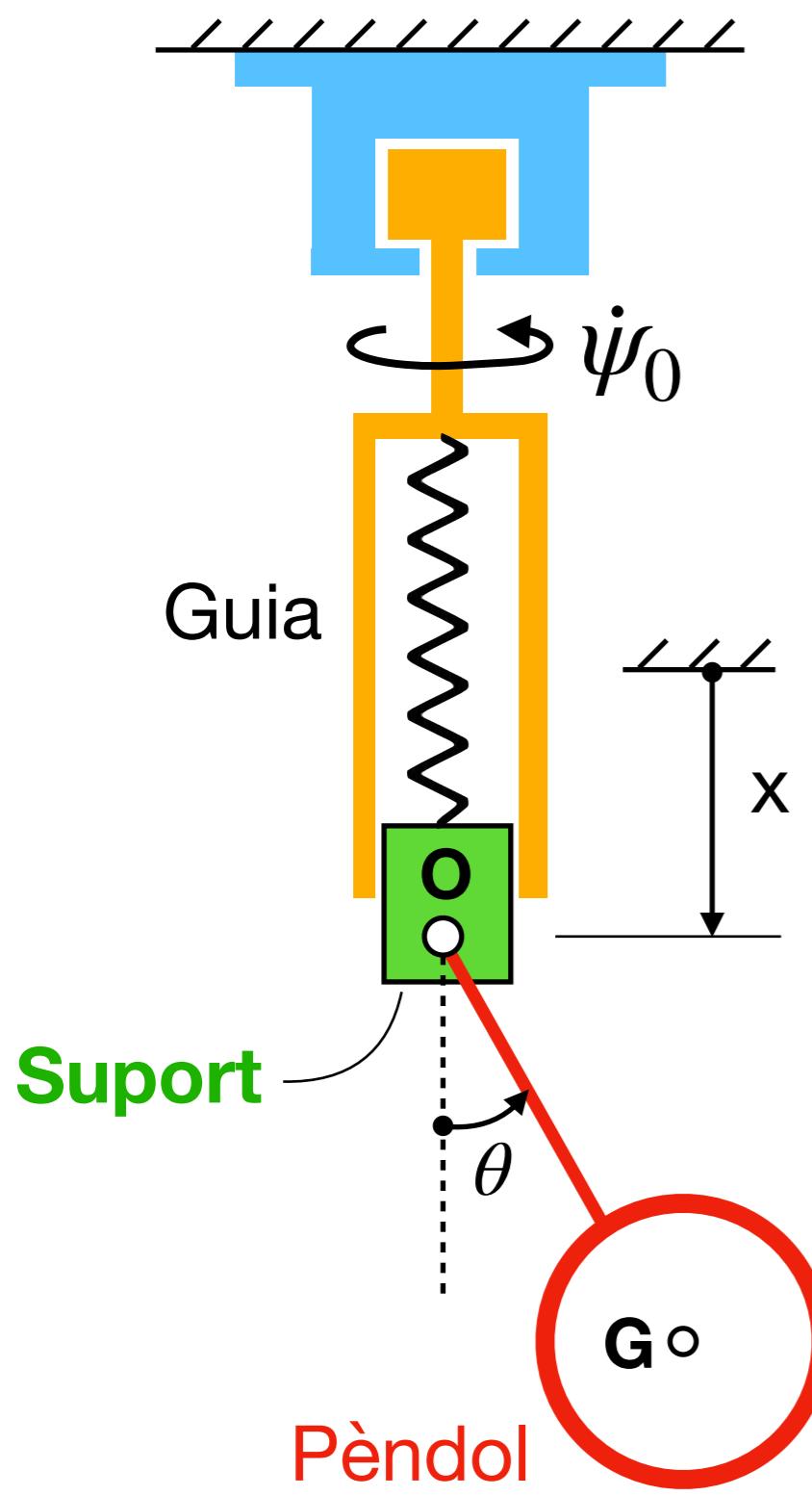
Amb motor aturat: $x = 0, \theta = 0$ és configuració d'equilibri.



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

Explorem sistemes que els incloguin

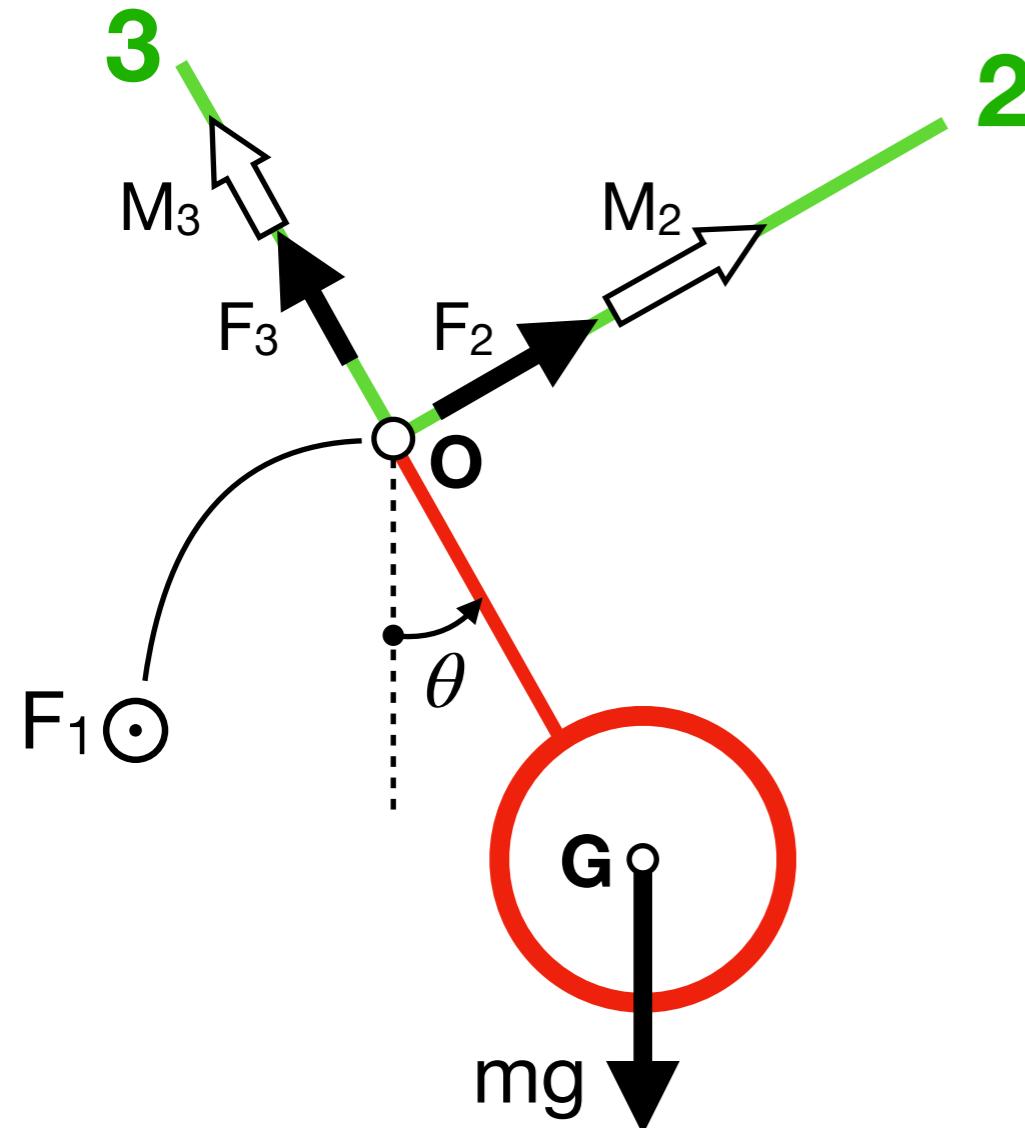




Sistema	Incògn.	Problema
Pèndol	$5\ ie, \ddot{x}, \ddot{\theta}$	INDET
Pènd. + sup.	$5\ ie, \ddot{x}, \ddot{\theta}$	INDET

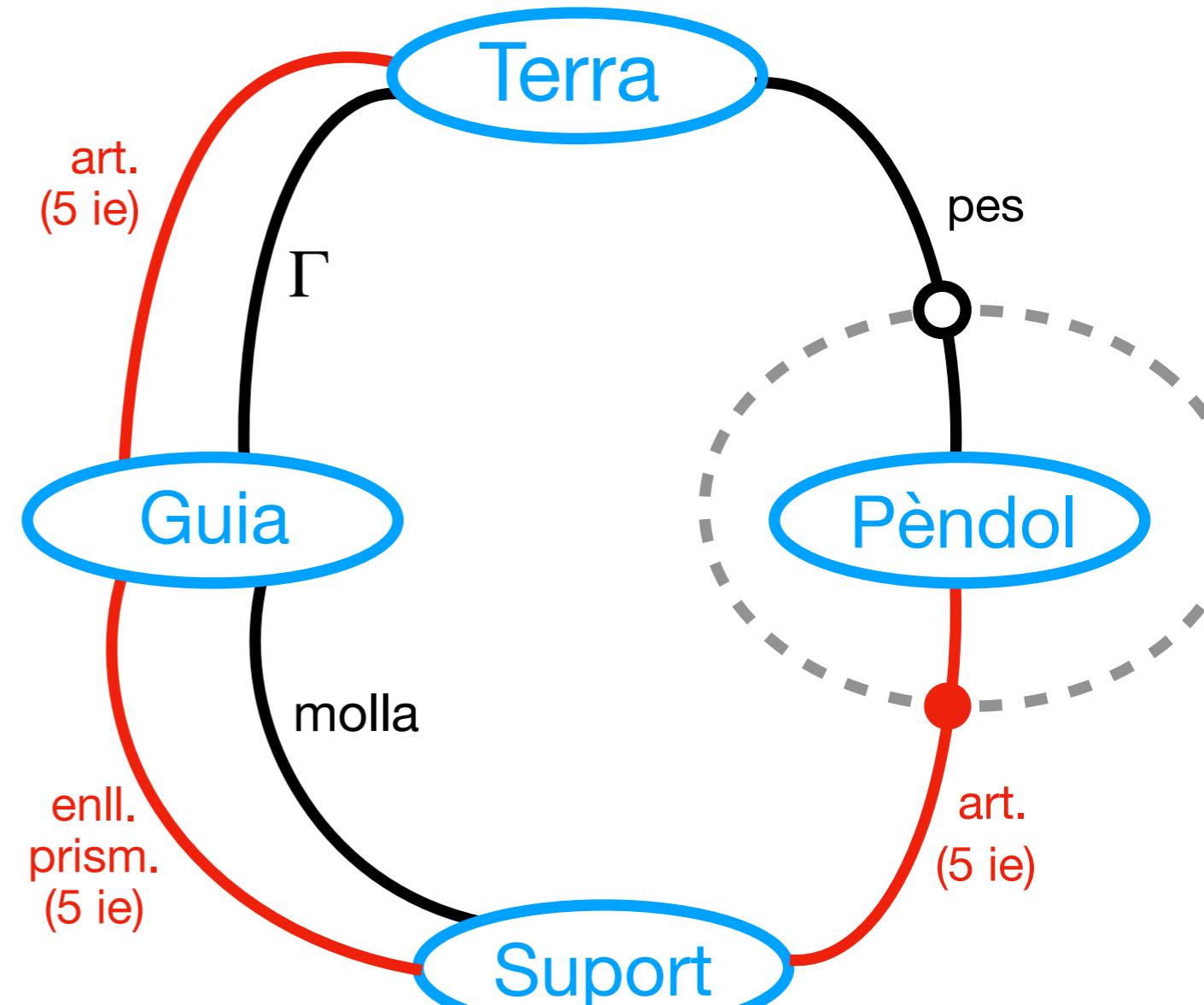
Els altres sistemes tenen + incògnites !

Sist = Pèndol

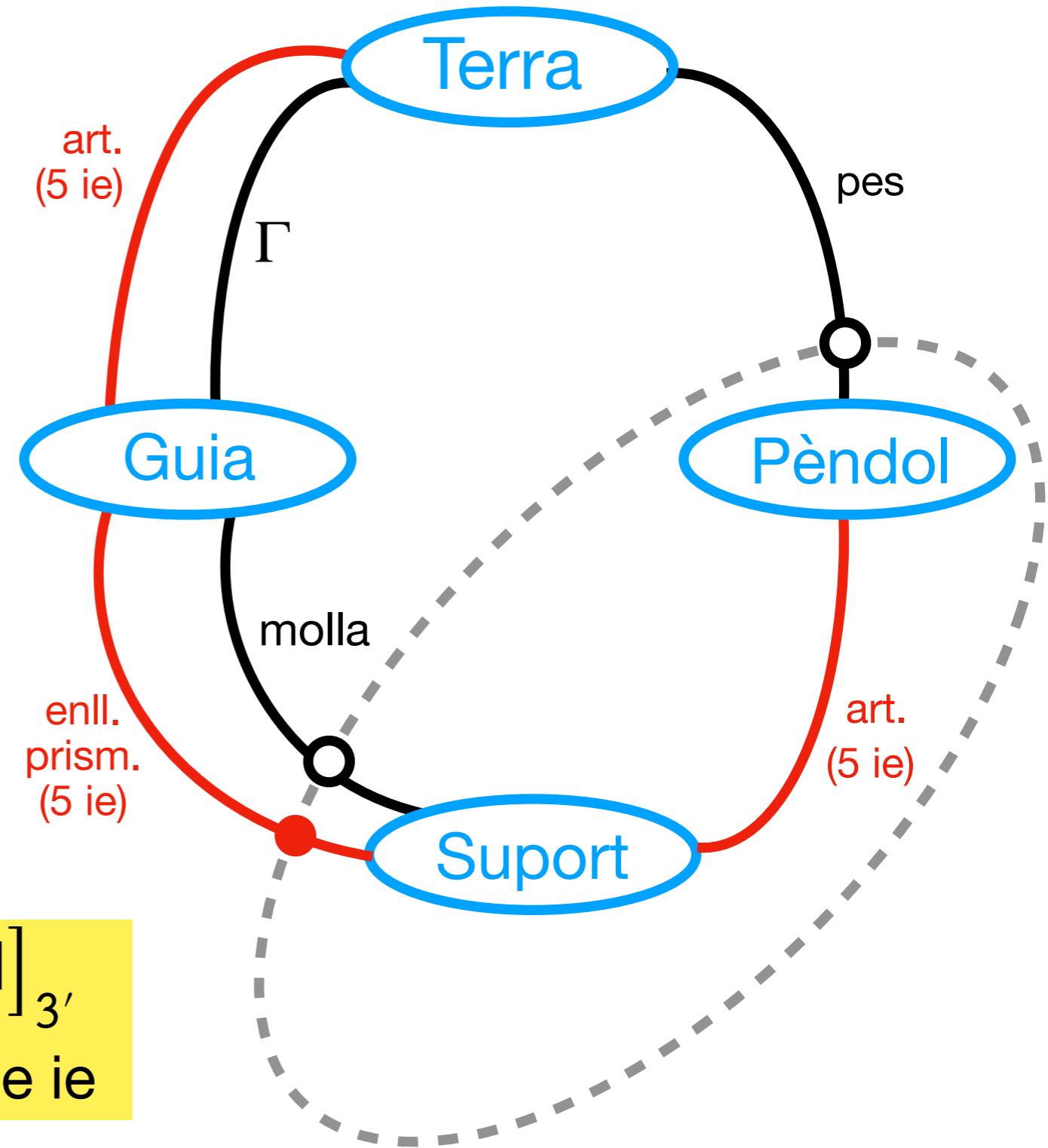
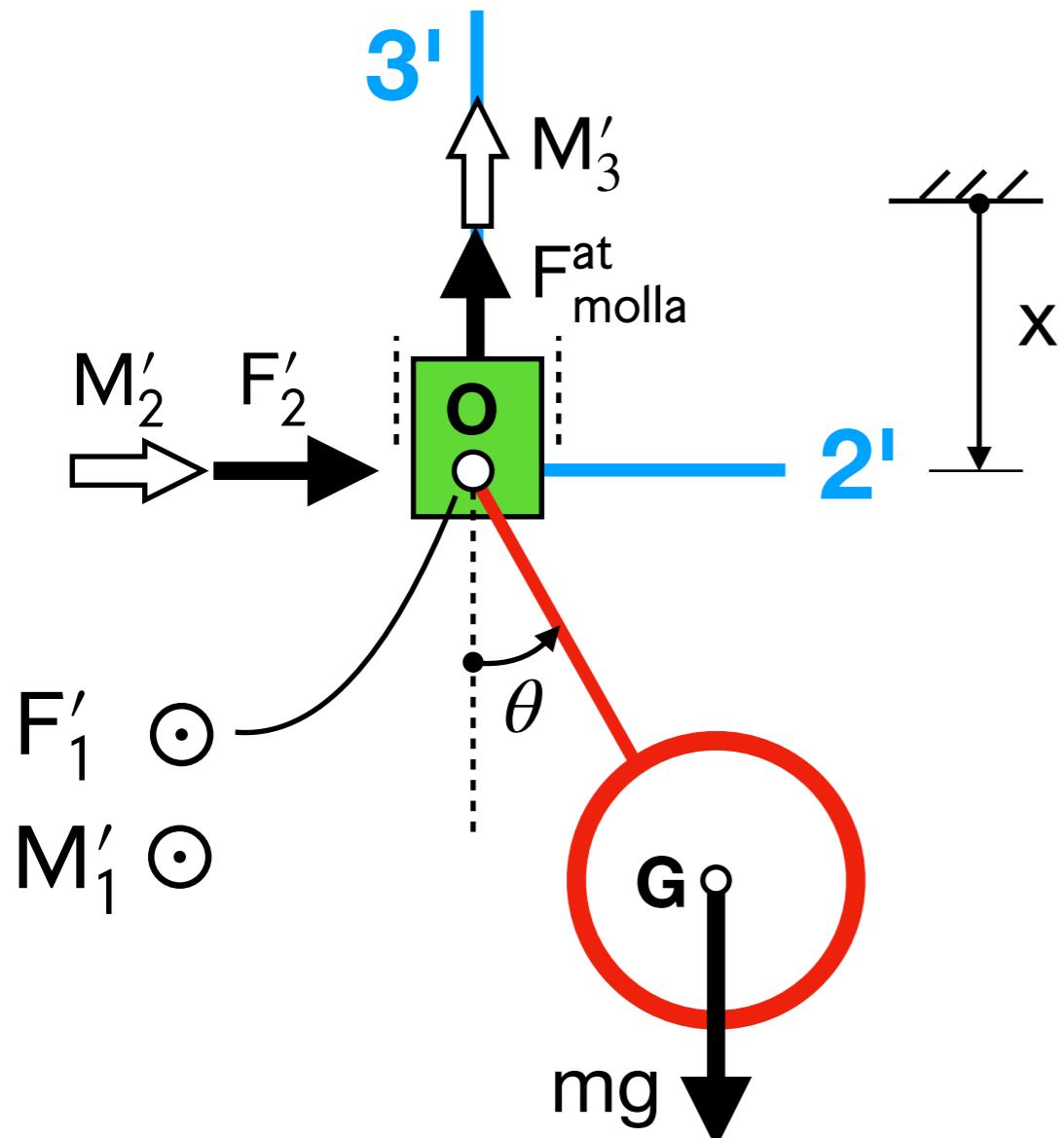


$$\left\{ \bar{F}_{\text{Sup} \rightarrow \text{Pendol}} \right\}_B = \begin{Bmatrix} F_1 \\ F_2 \\ F_3 \end{Bmatrix}$$

$$\left\{ \bar{M}_{\text{Sup} \rightarrow \text{Pendol}} (\mathbf{O}) \right\}_B = \begin{Bmatrix} 0 \\ M_2 \\ M_3 \end{Bmatrix} \leftarrow \boxed{\text{TMC}(\mathbf{O})}_1 \quad \text{Illiure de ie}$$



Sist = Pèndol + Suport

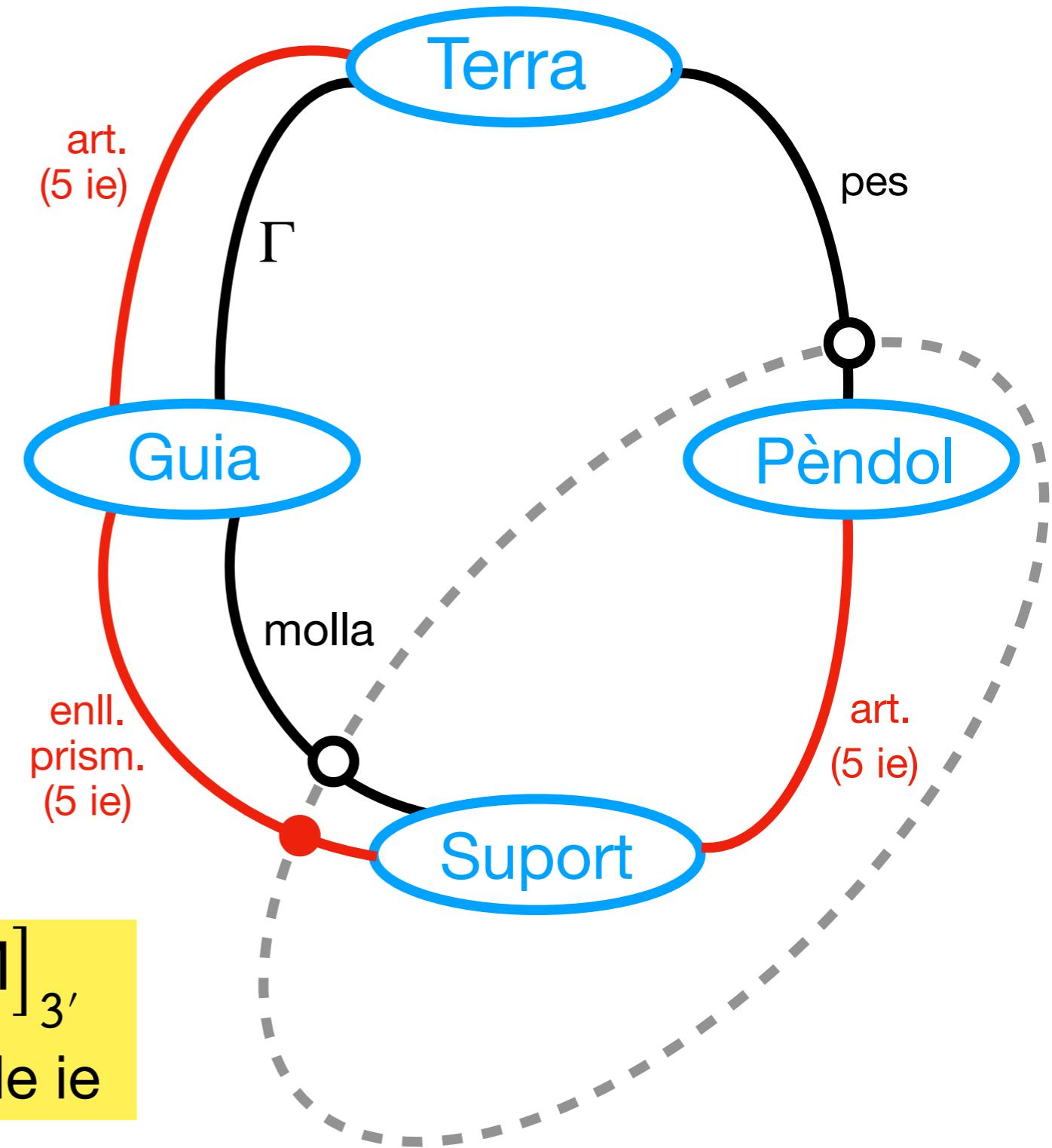
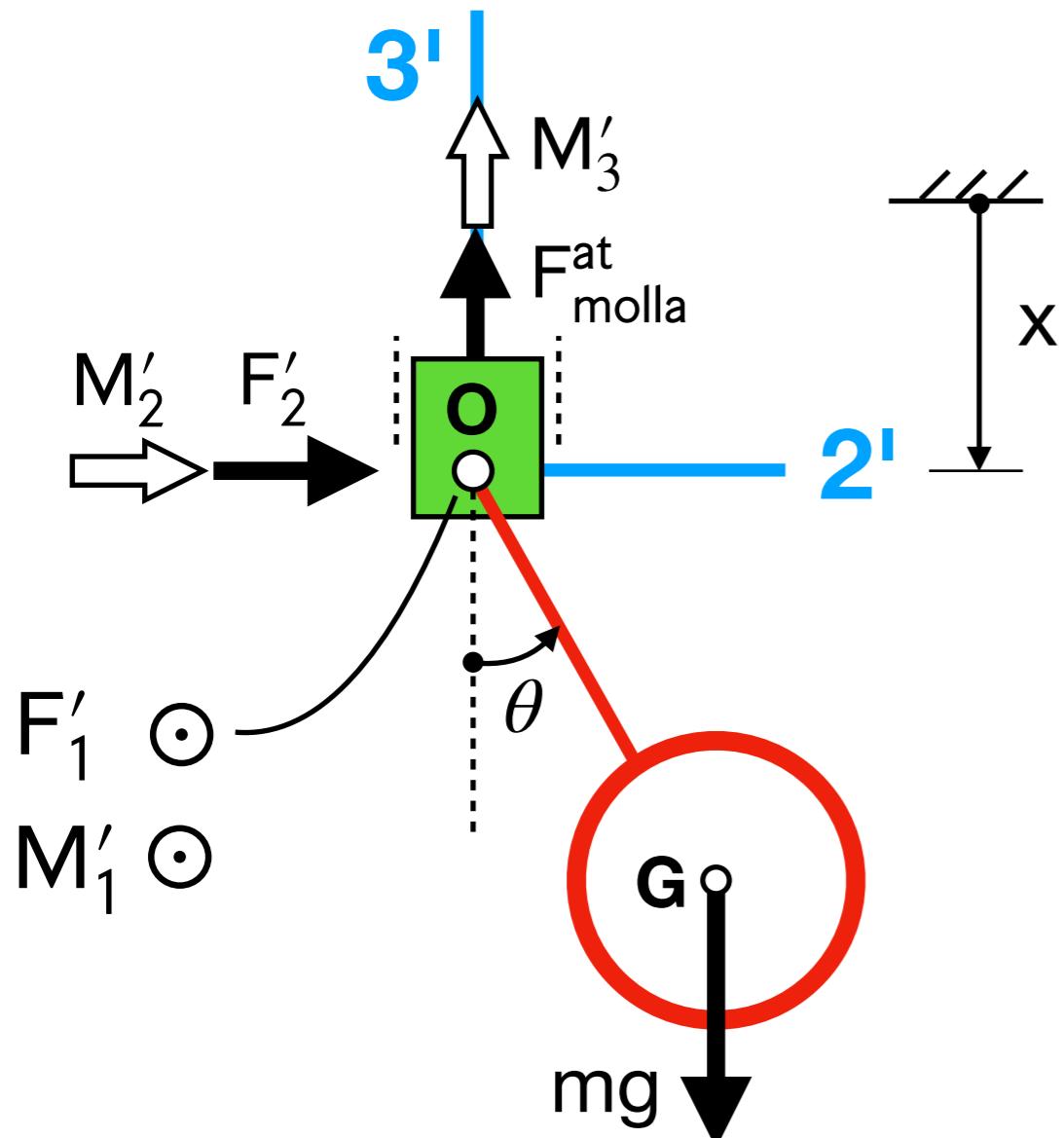


$$\left\{ \bar{F}_{\text{Guia} \rightarrow \text{Sup}} \right\}_{B'} = \begin{Bmatrix} F'_1 \\ F'_2 \\ 0 \end{Bmatrix}$$

TQM] $_{3'}$
lliure de ie

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

Sist = Pèndol + Suport

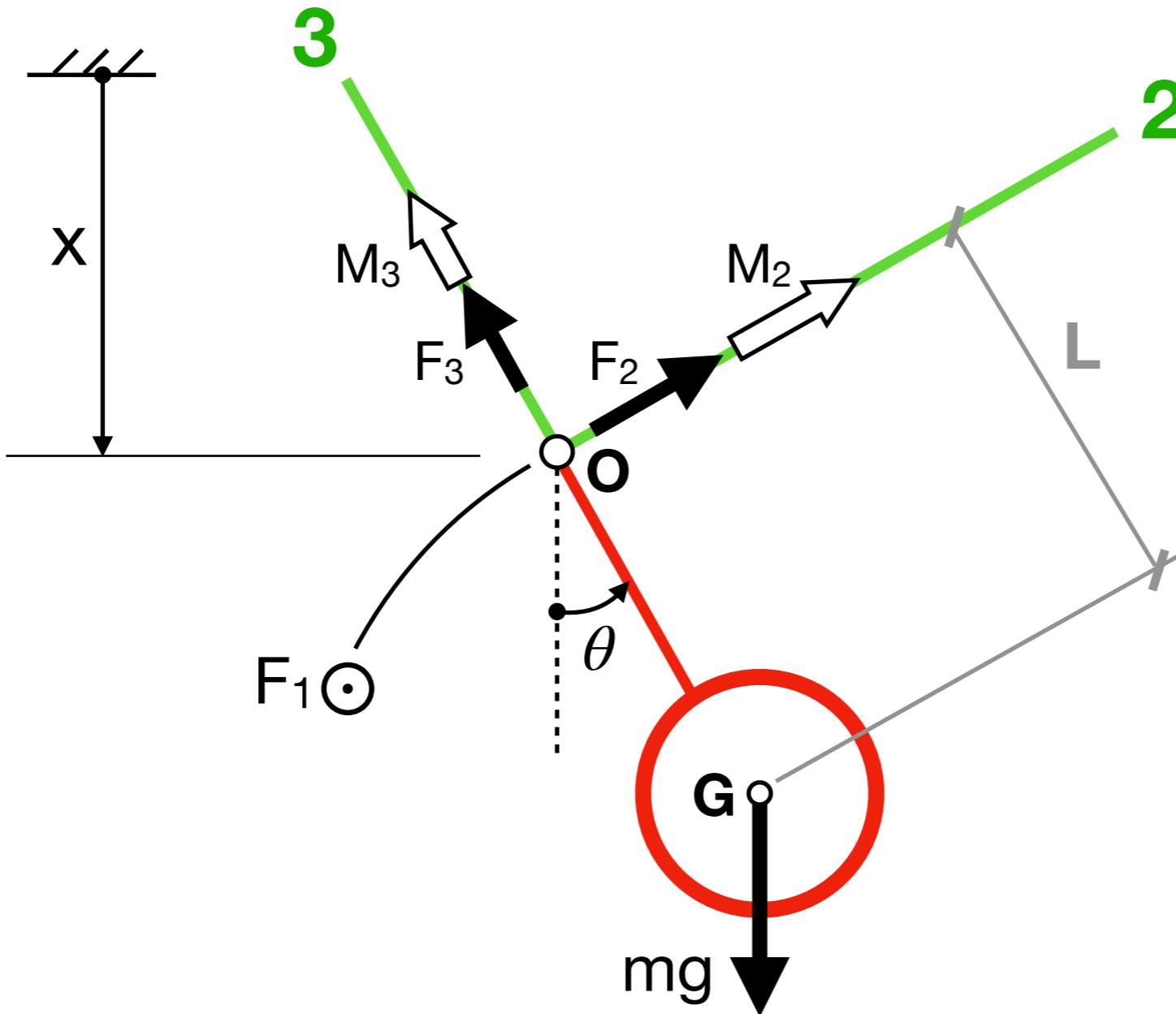


$$\left\{ \bar{F}_{\text{Guia} \rightarrow \text{Sup}} \right\}_{B'} = \begin{Bmatrix} F'_1 \\ F'_2 \\ 0 \end{Bmatrix}$$

TQM] _{3'}
lliure de ie

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

TMC(O)]₁ sobre SIST = Pèndol



TMC(O)]₁ sobre SIST = Pèndol

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

Pas final

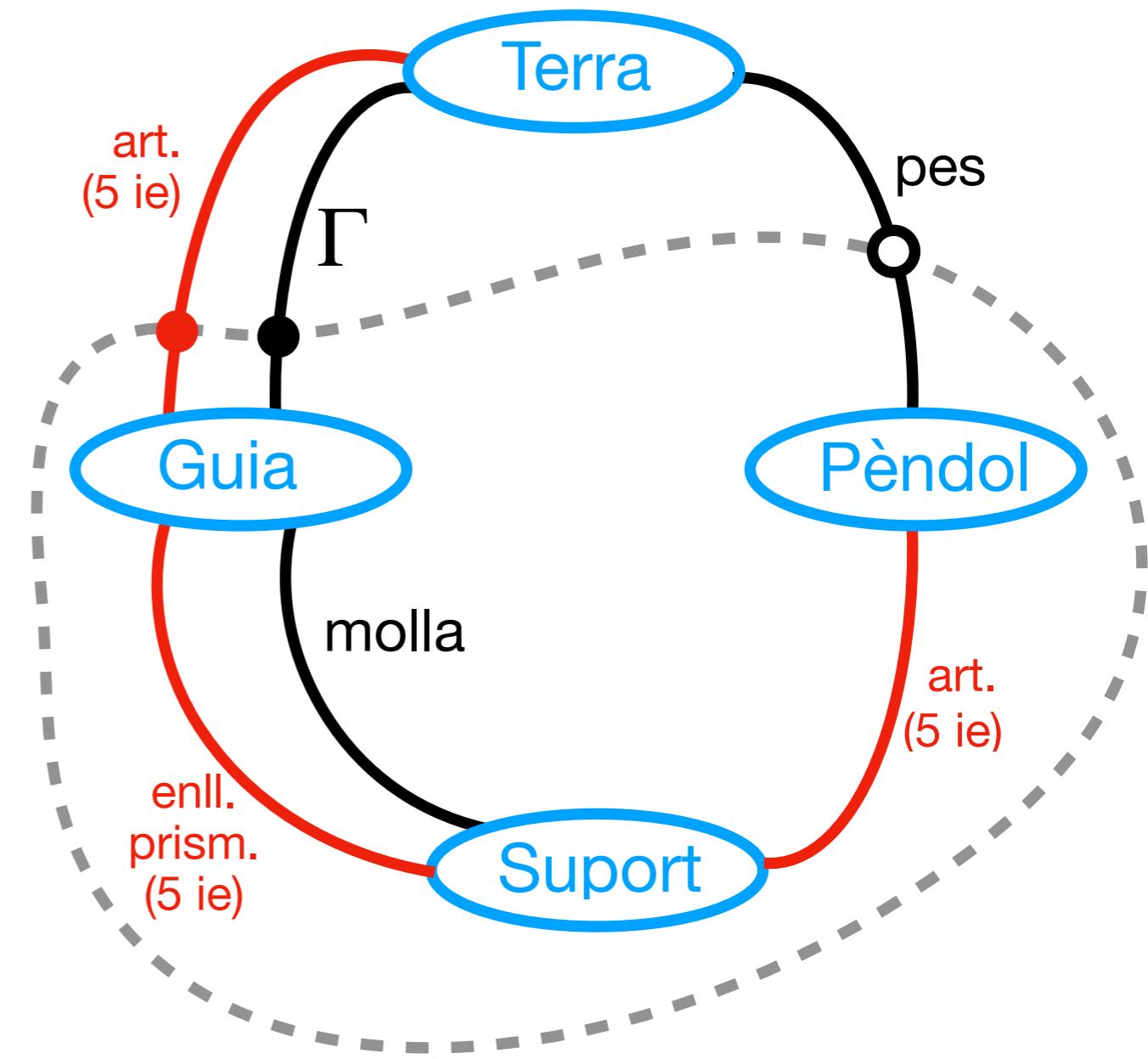
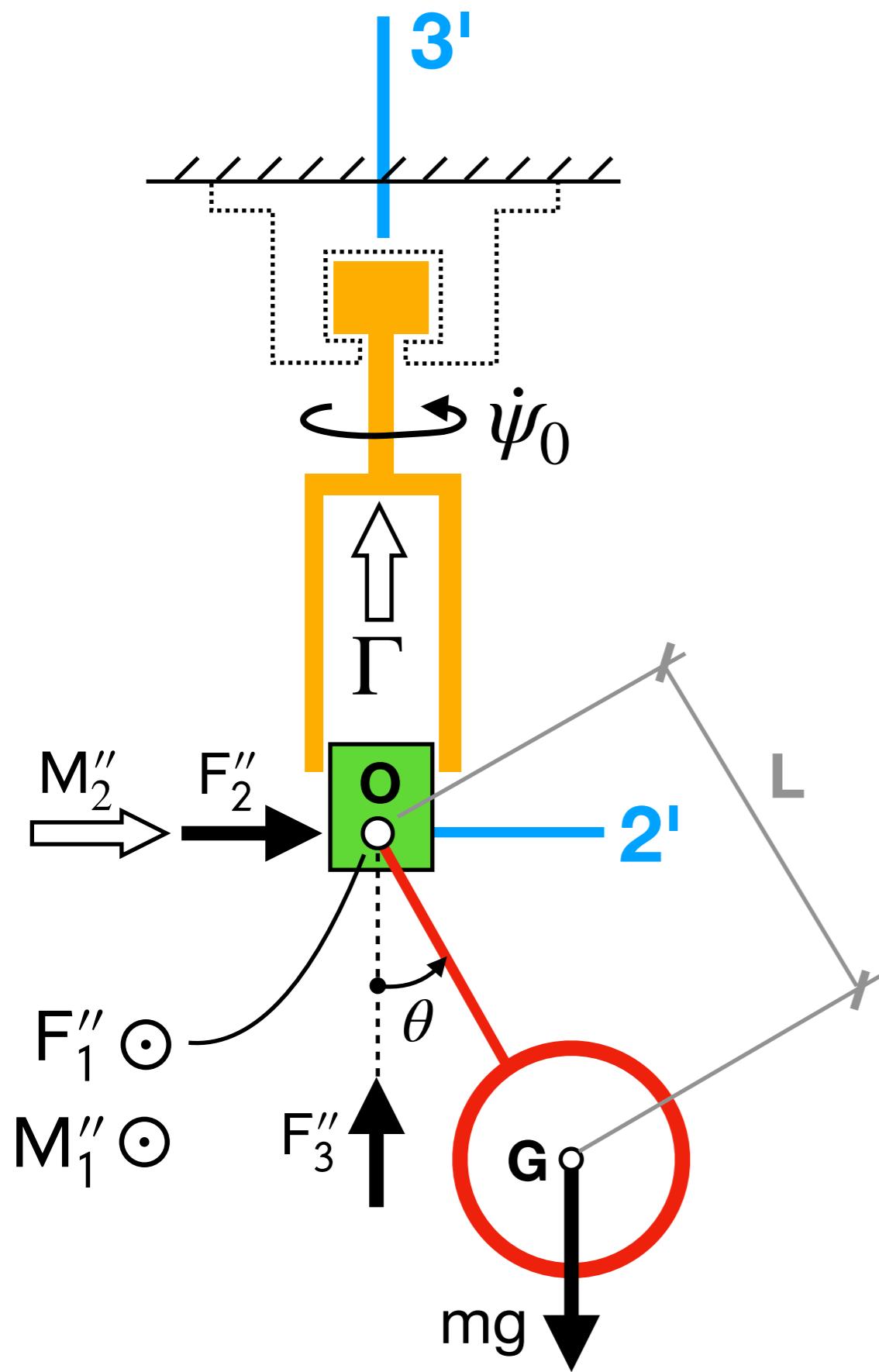
$$\left\{ \begin{array}{l} (R^2 + L^2) \ddot{\theta} - (L \sin \theta) \ddot{x} = (L \dot{\psi}_0^2 \cos \theta - g) L \sin \theta \\ - (L \sin \theta) \ddot{\theta} + \ddot{x} = - \frac{k}{m} x + L \dot{\theta}^2 \cos \theta \end{array} \right.$$

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

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

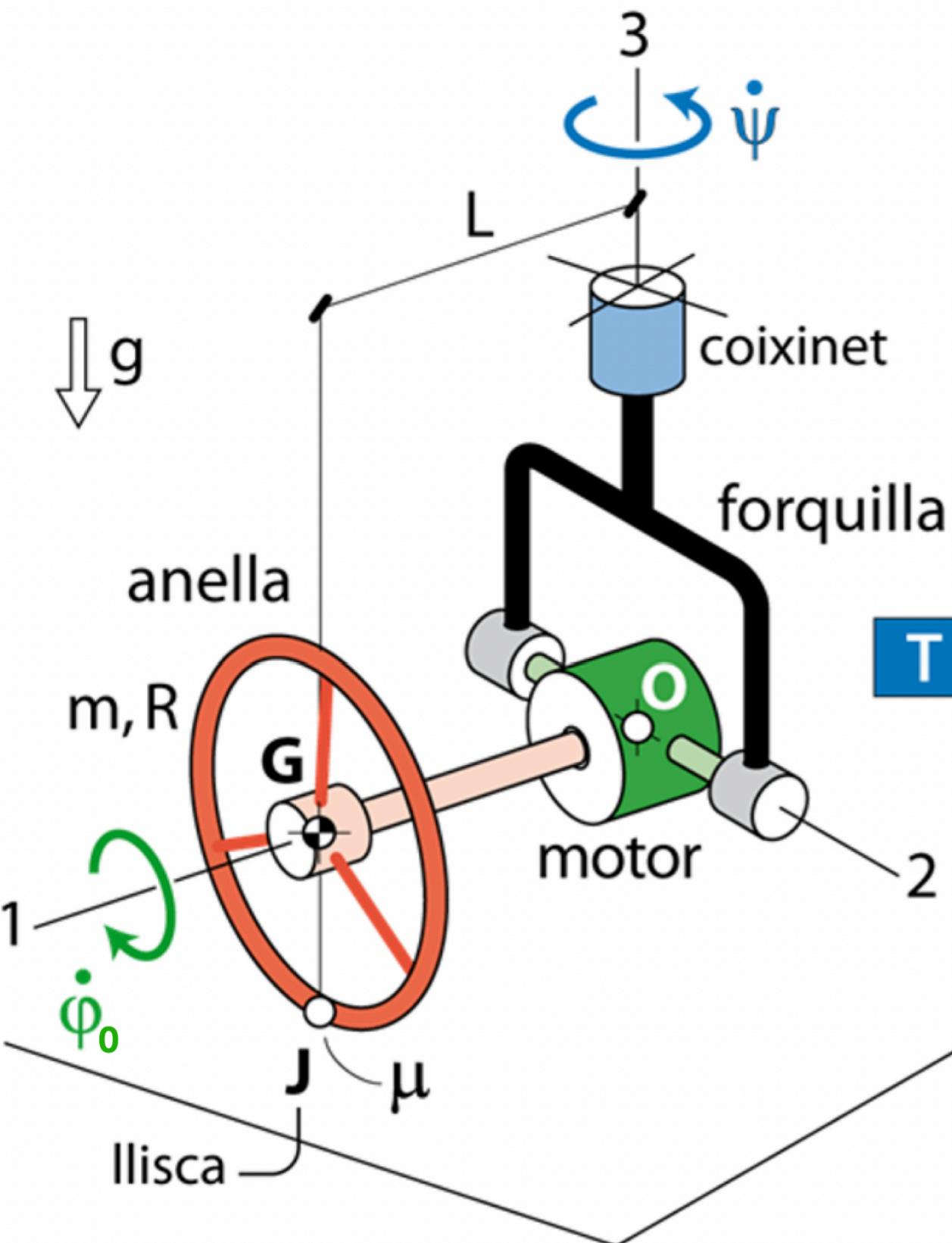
No cal
que
ho feu

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



D'abans

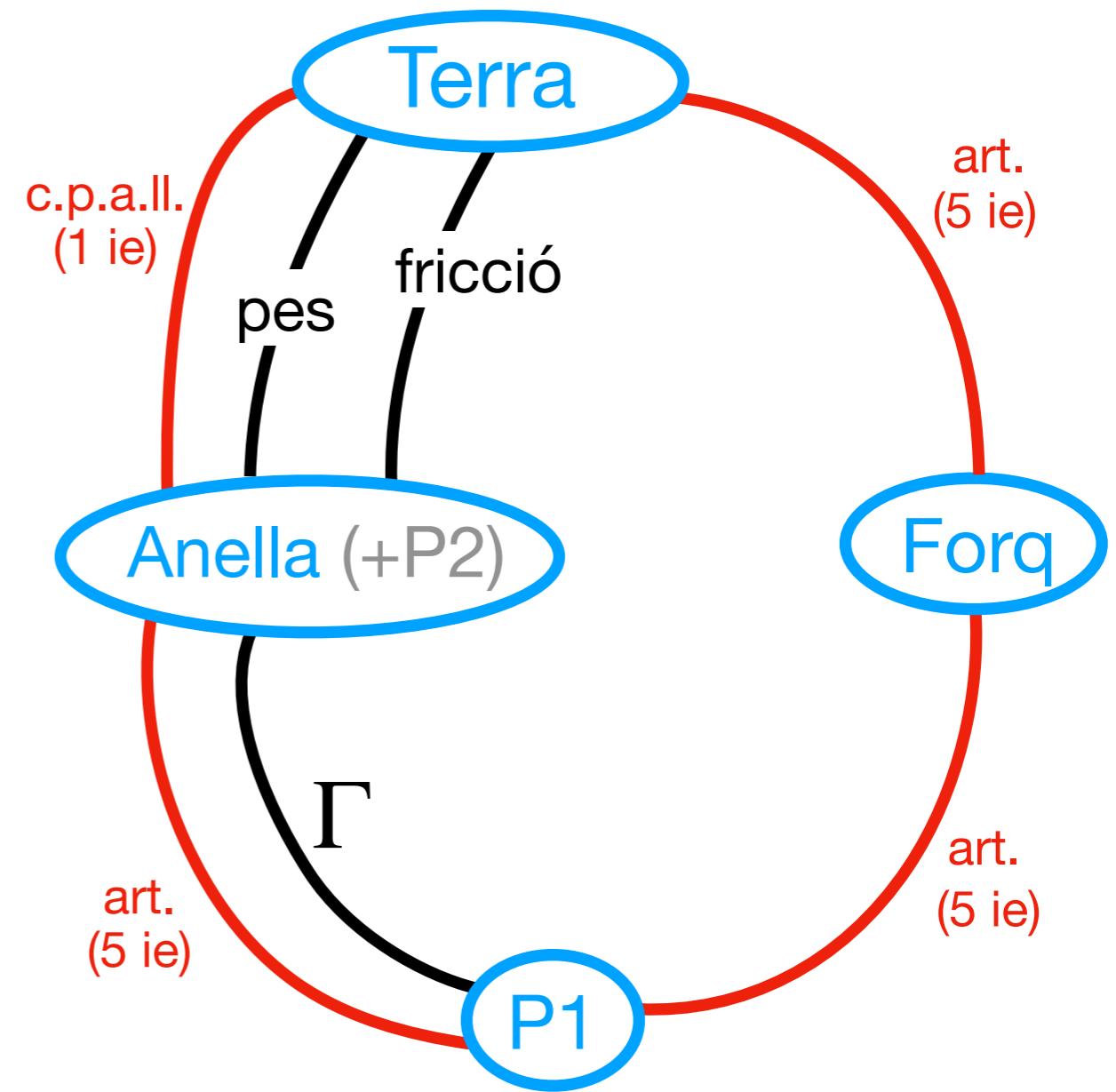
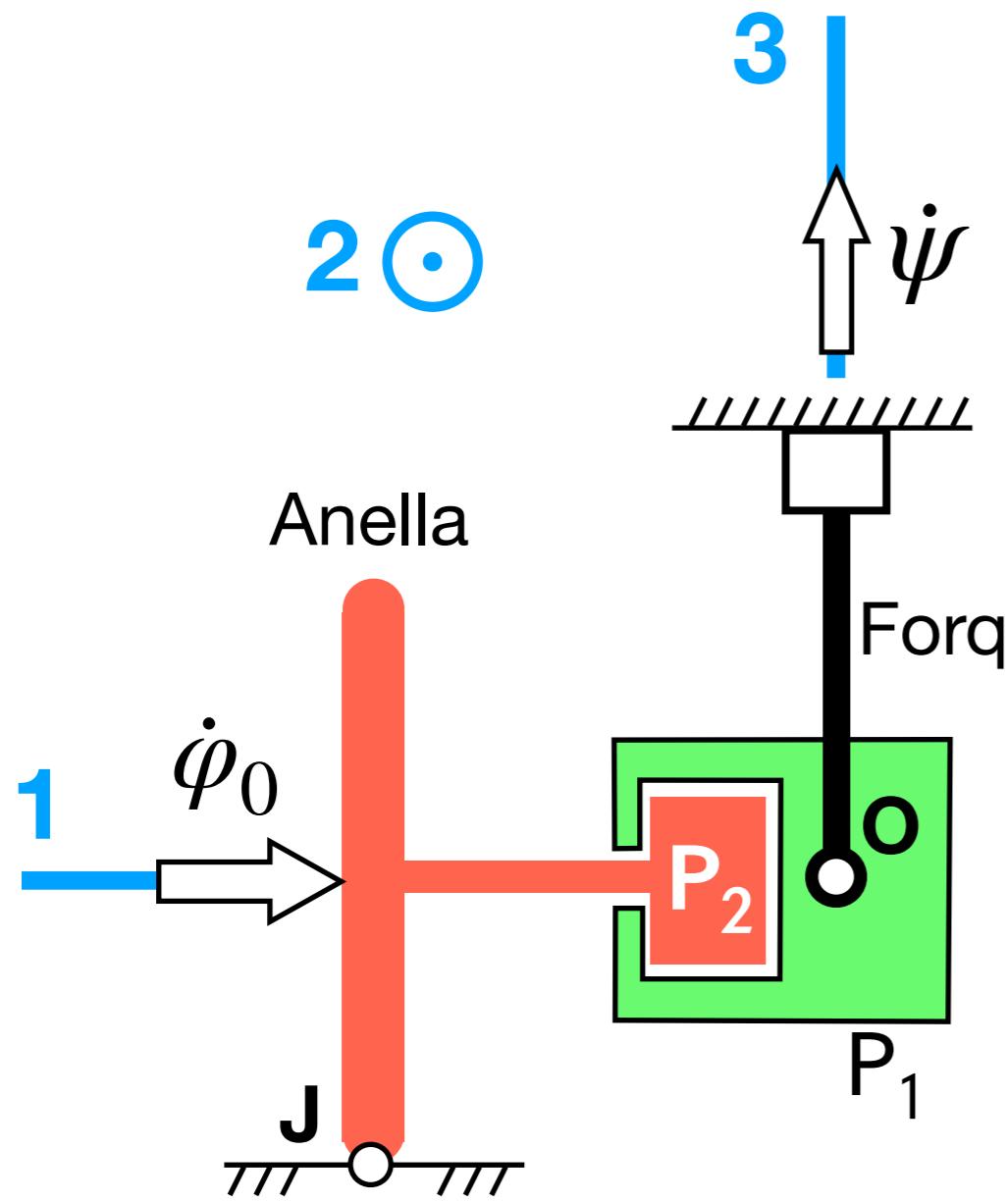
$$\left\{ \dot{\bar{H}}_{RTO}(\mathbf{O}) \right\}_B = \begin{Bmatrix} I_{11} \ddot{\theta} + (I_{33} - I_{22}) \dot{\psi}_0^2 \sin \theta \cos \theta \\ (I_{11} + I_{22} - I_{33}) \dot{\psi}_0 \dot{\theta} \cos \theta \\ (I_{22} - I_{11} - I_{33}) \dot{\psi}_0 \dot{\theta} \sin \theta \end{Bmatrix}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



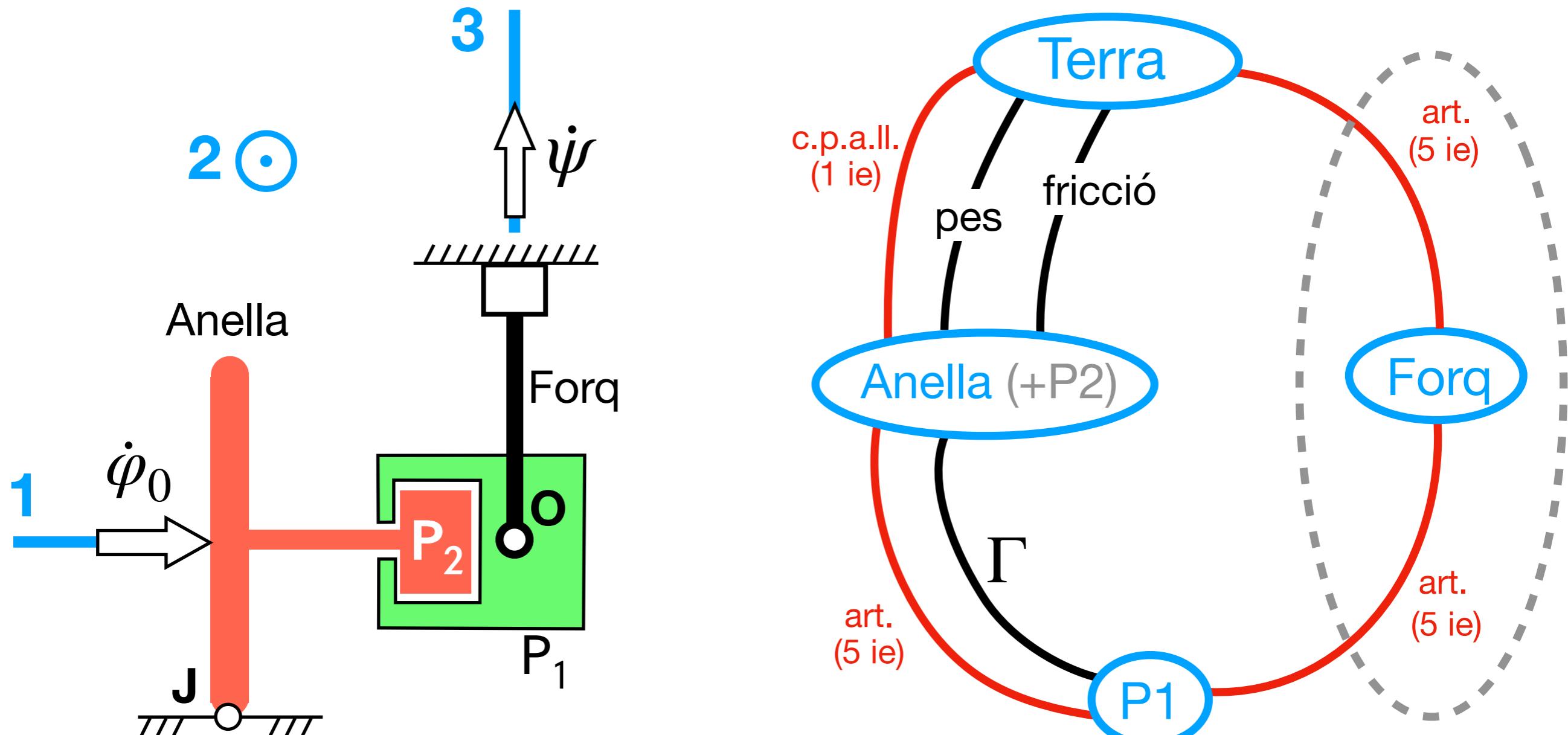
- GL sistema?
- DGI
- Caracterització de torsors?
- Eq. mov per a la coord. ψ
- Força normal a J
- Parell motor per mantenir $\dot{\phi}_0$

Manté contacte puntual a J

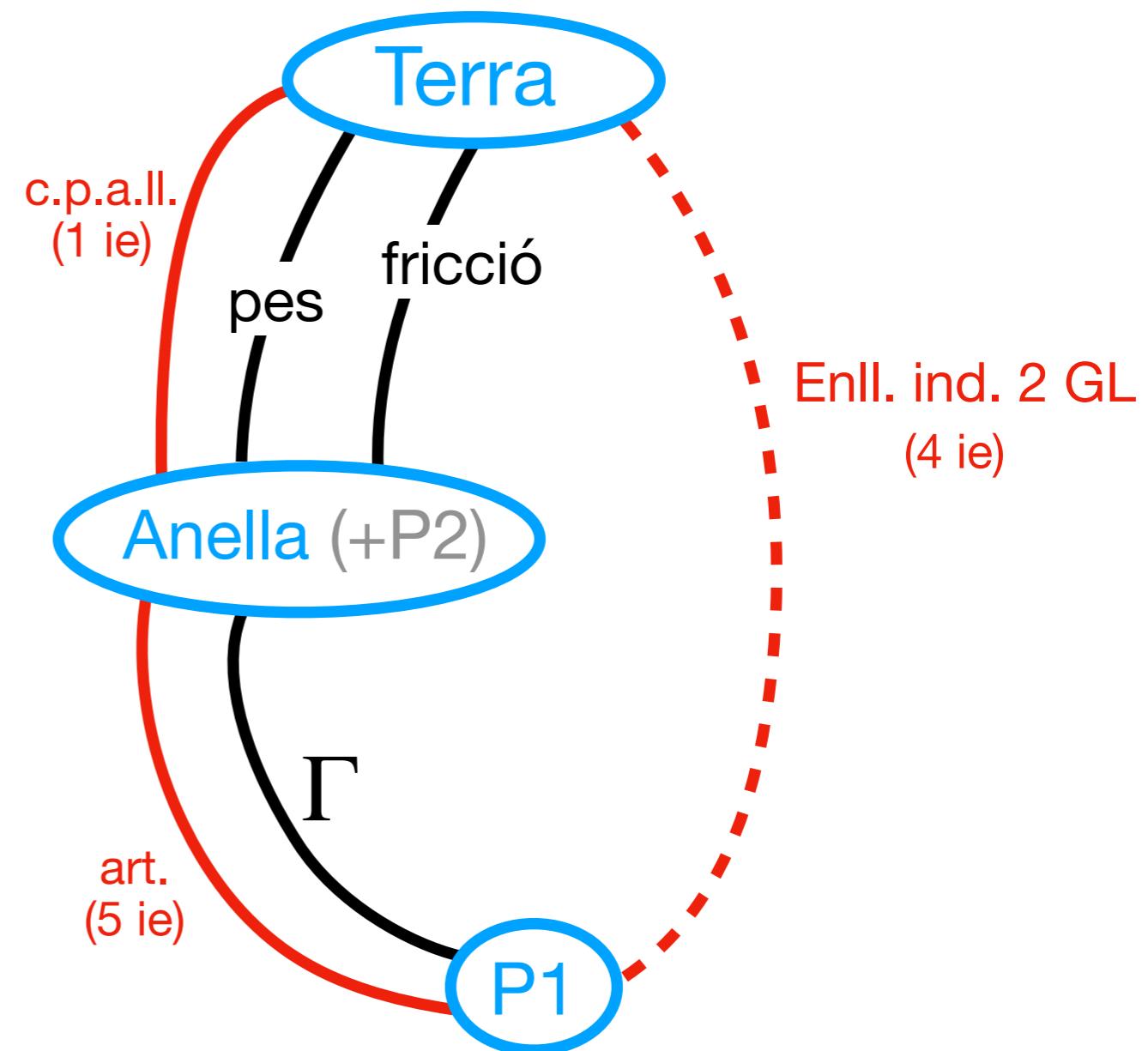
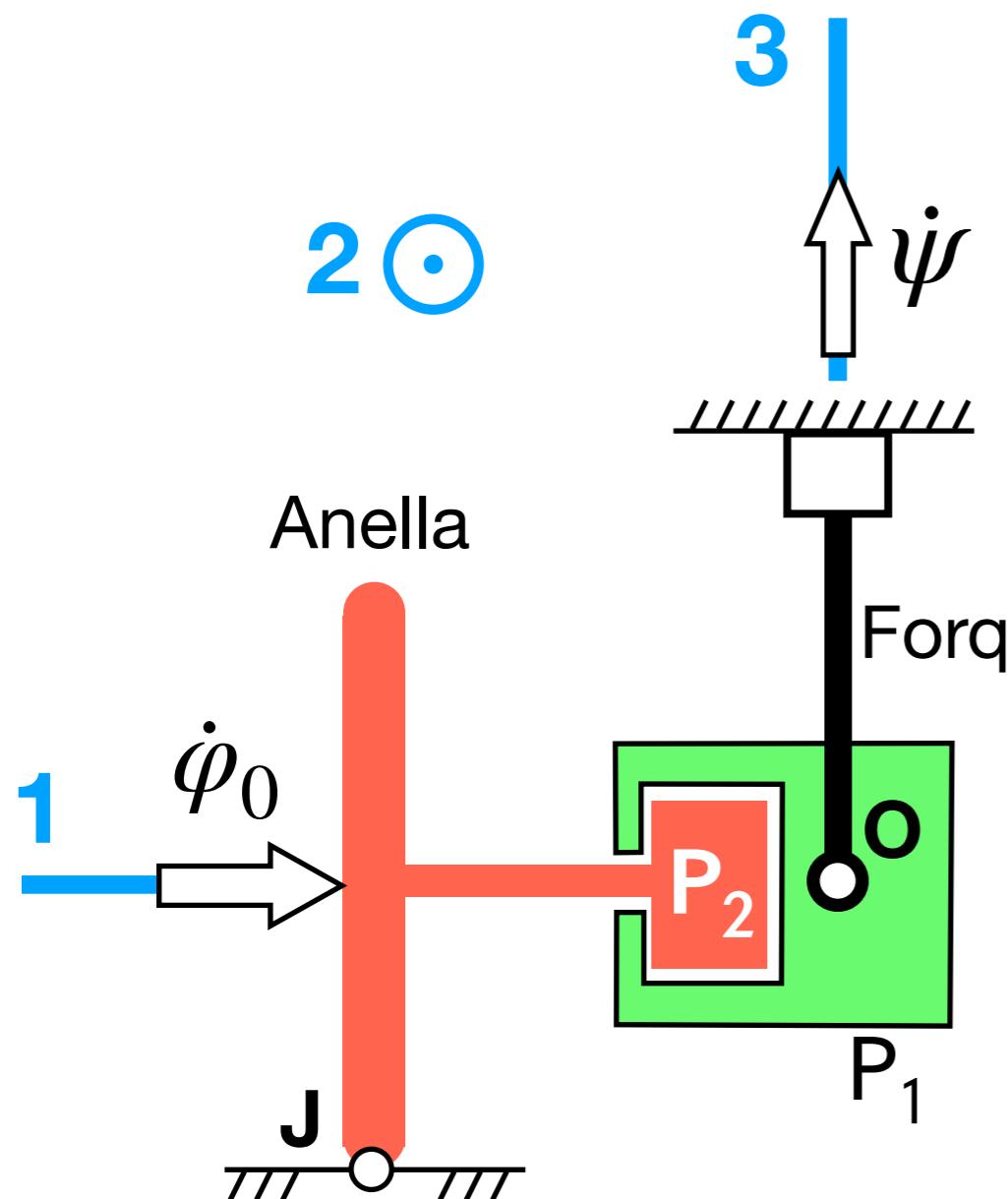
Motor manté $\dot{\phi}_0 = \text{ct}$



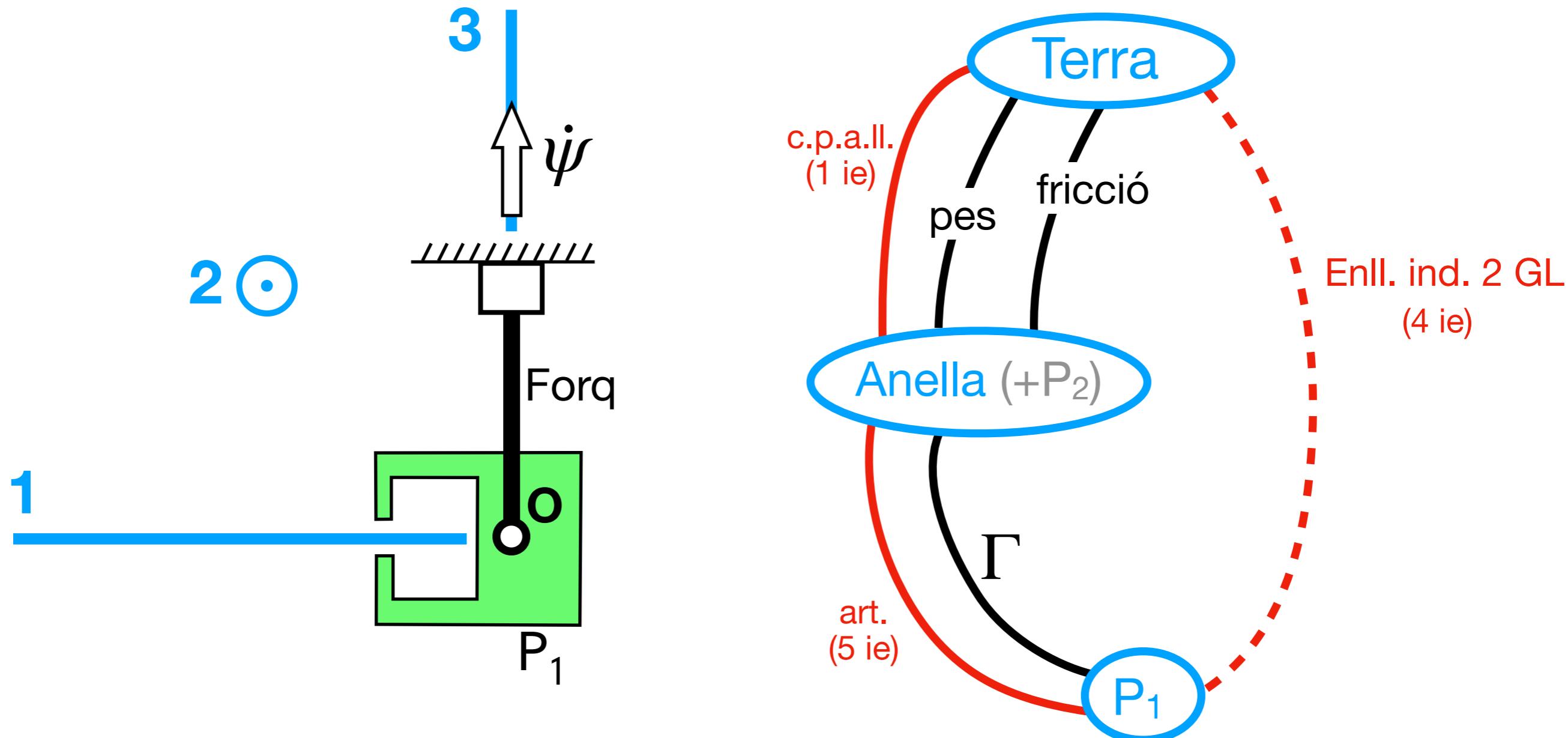
Forq és SAE \Rightarrow Substituim-la per l'enllaç indirecte $T \rightarrow P_1$



Forq és SAE \Rightarrow Substituim-la per l'enllaç indirecte $T \rightarrow P_1$



Forq és SAE \Rightarrow Substituim-la per l'enllaç indirecte $T \rightarrow P_1$



Torsor d'enllaç indirecte

$$\left\{ \bar{\mathbf{F}}_{T \rightarrow (\text{forq}) \rightarrow \text{Sup}} \right\}_B = \begin{Bmatrix} \mathbf{F}_1 \\ \mathbf{F}_2 \\ \mathbf{F}_3 \end{Bmatrix} \quad O \text{ és fix a } T$$

$$\left\{ \bar{\mathbf{M}}_{T \rightarrow (\text{forq}) \rightarrow \text{Sup}} (\mathbf{O}) \right\}_{B'} = \begin{Bmatrix} \mathbf{M}_1 \\ 0 \\ 0 \end{Bmatrix}$$

Zeros en les rotacions permeses de P_1 respecte de T

Full ruta per eq. del mov. ψ

ψ afecta la cinemàtica de P1 i la de l'anella



Sistema 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

