

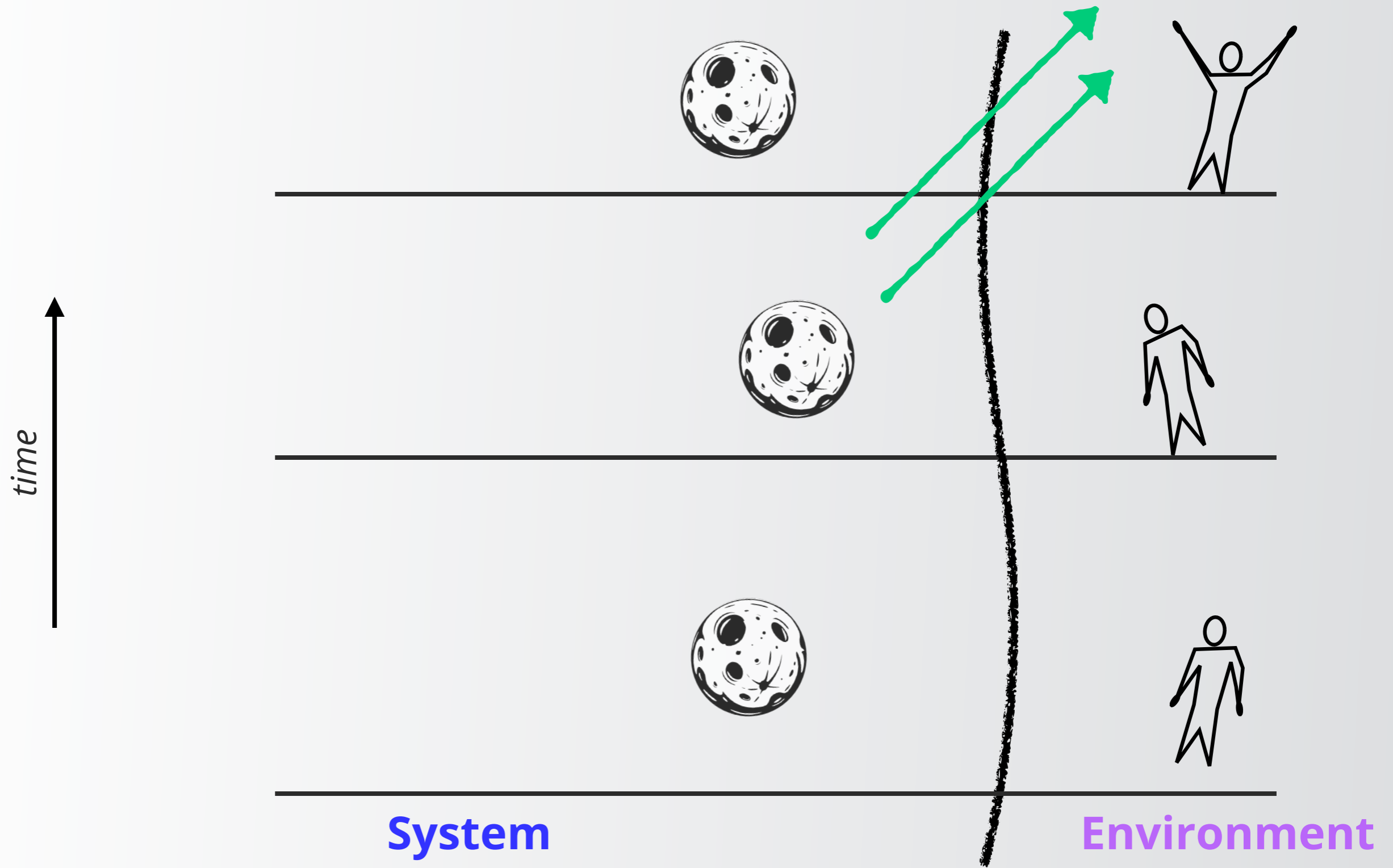
In gravity, any subsystem is an open system

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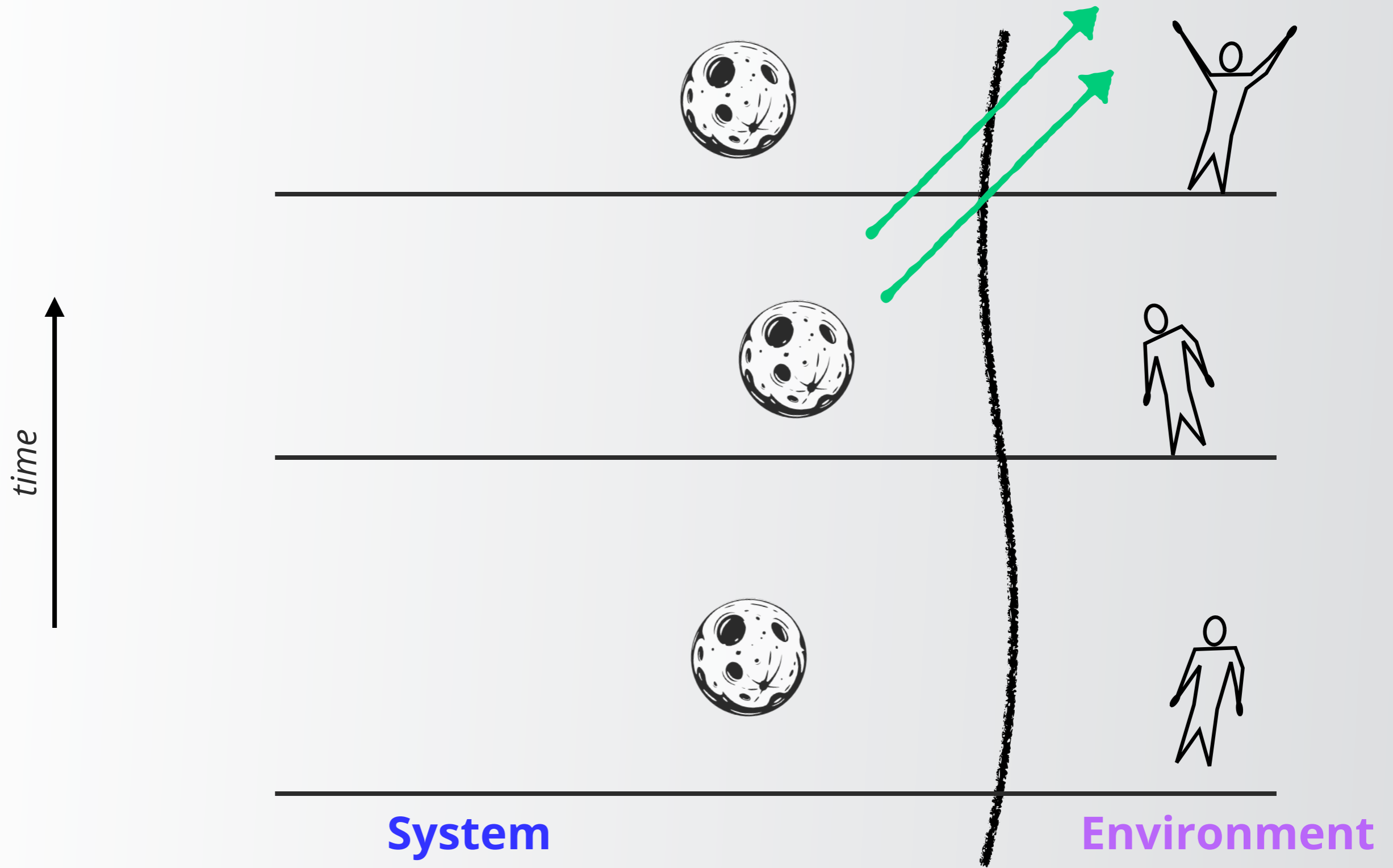
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**Based on joint research
with Viktoria Kabel**

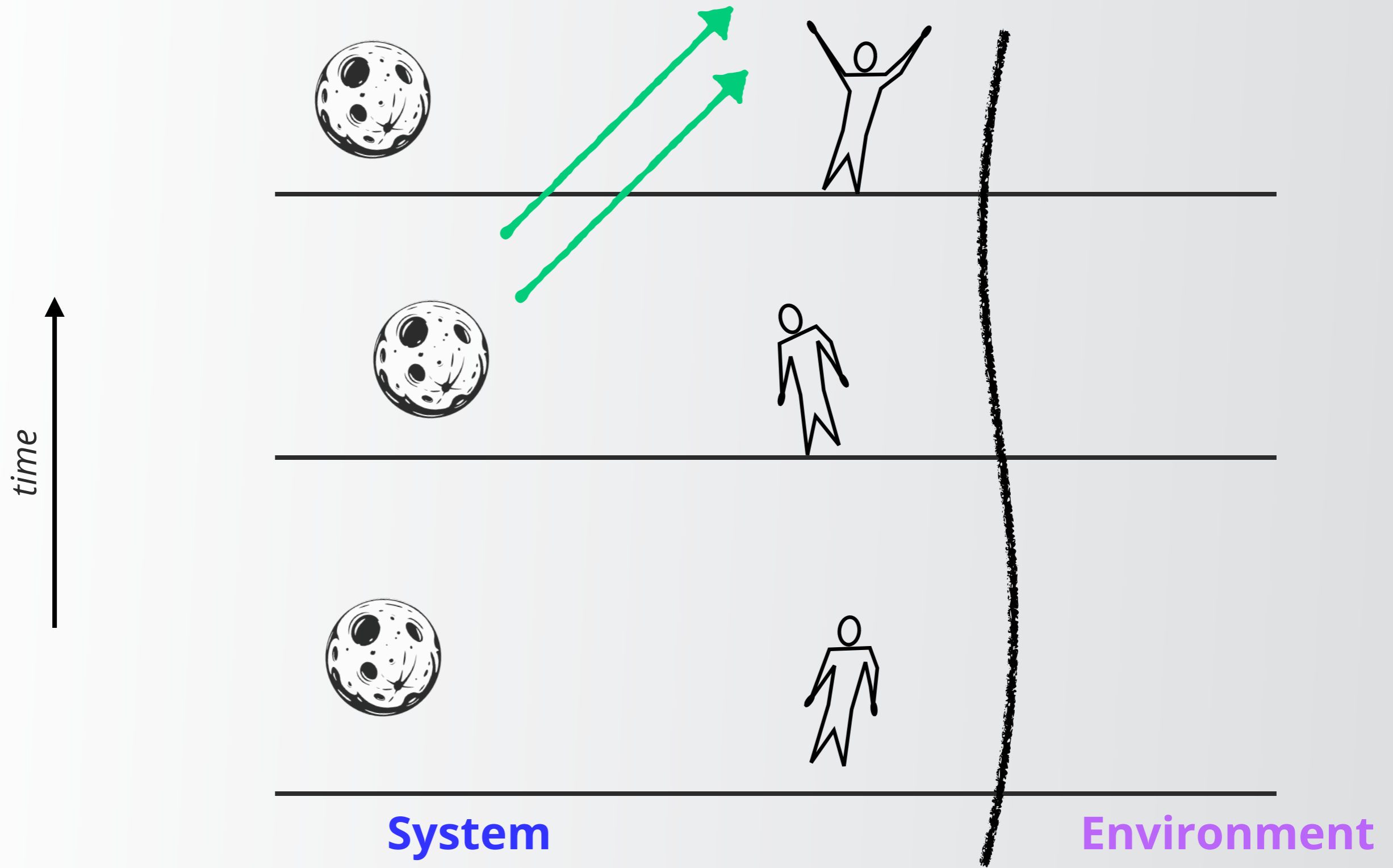
Large diffeos are not gauge



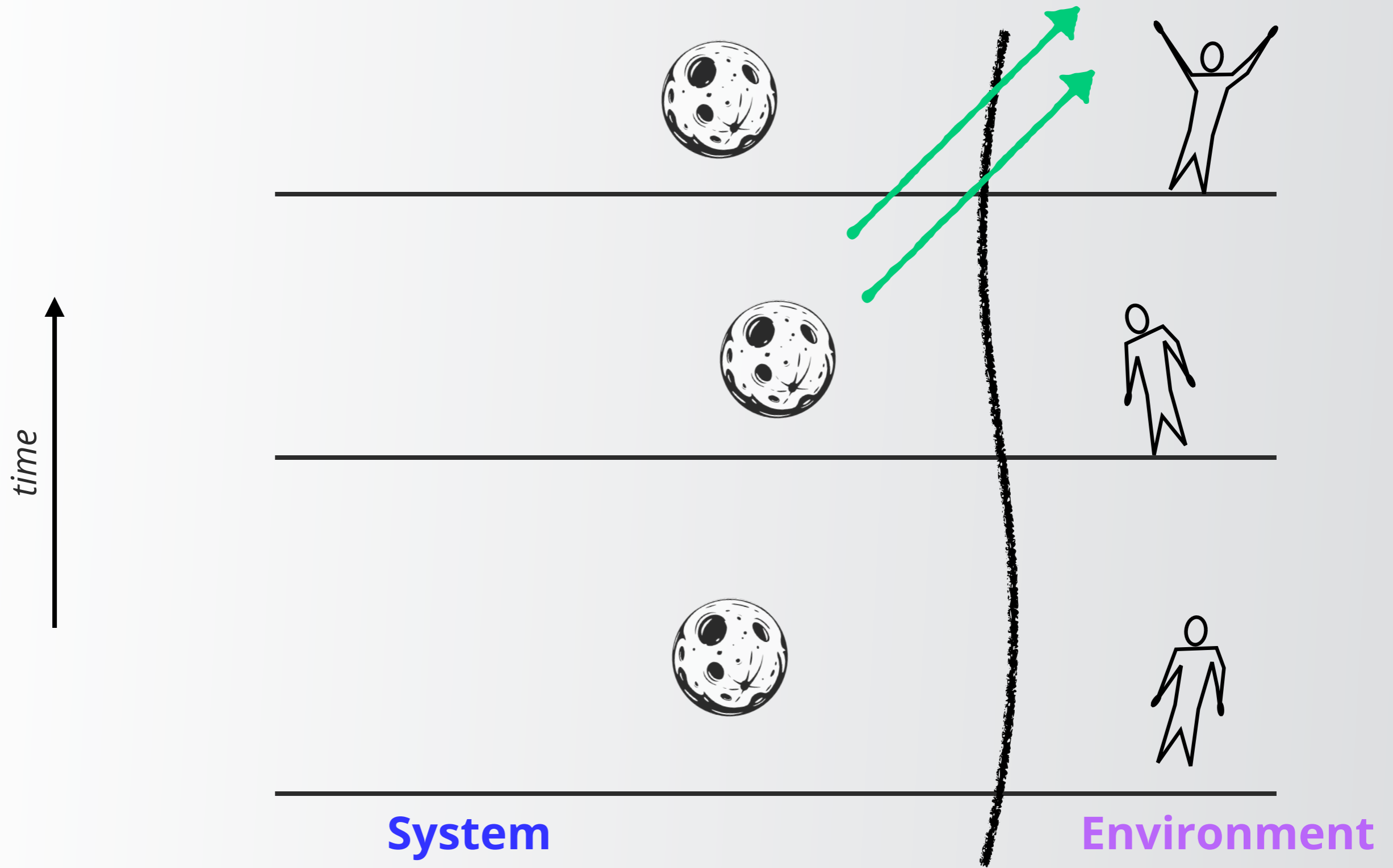
Large diffeos are not gauge



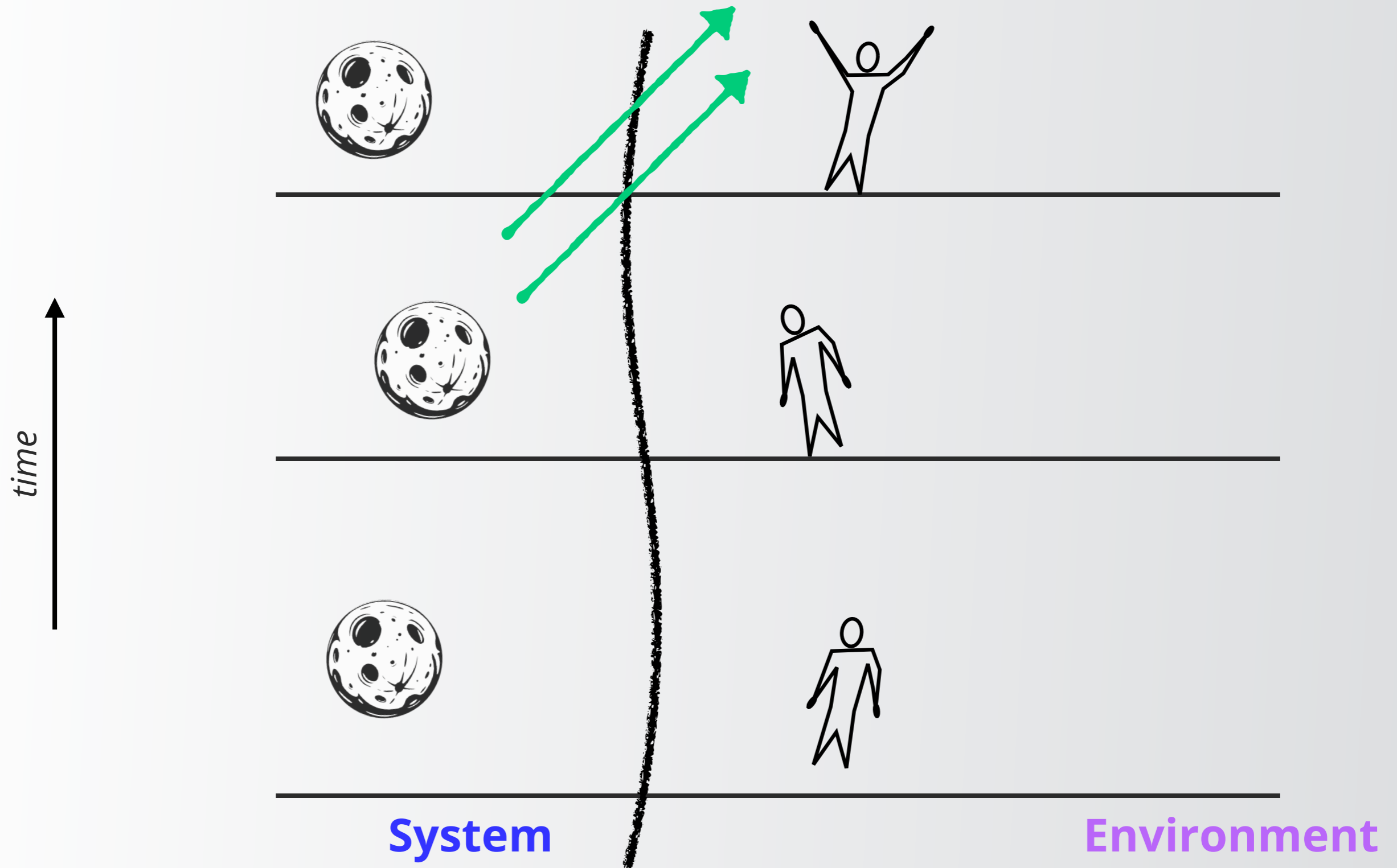
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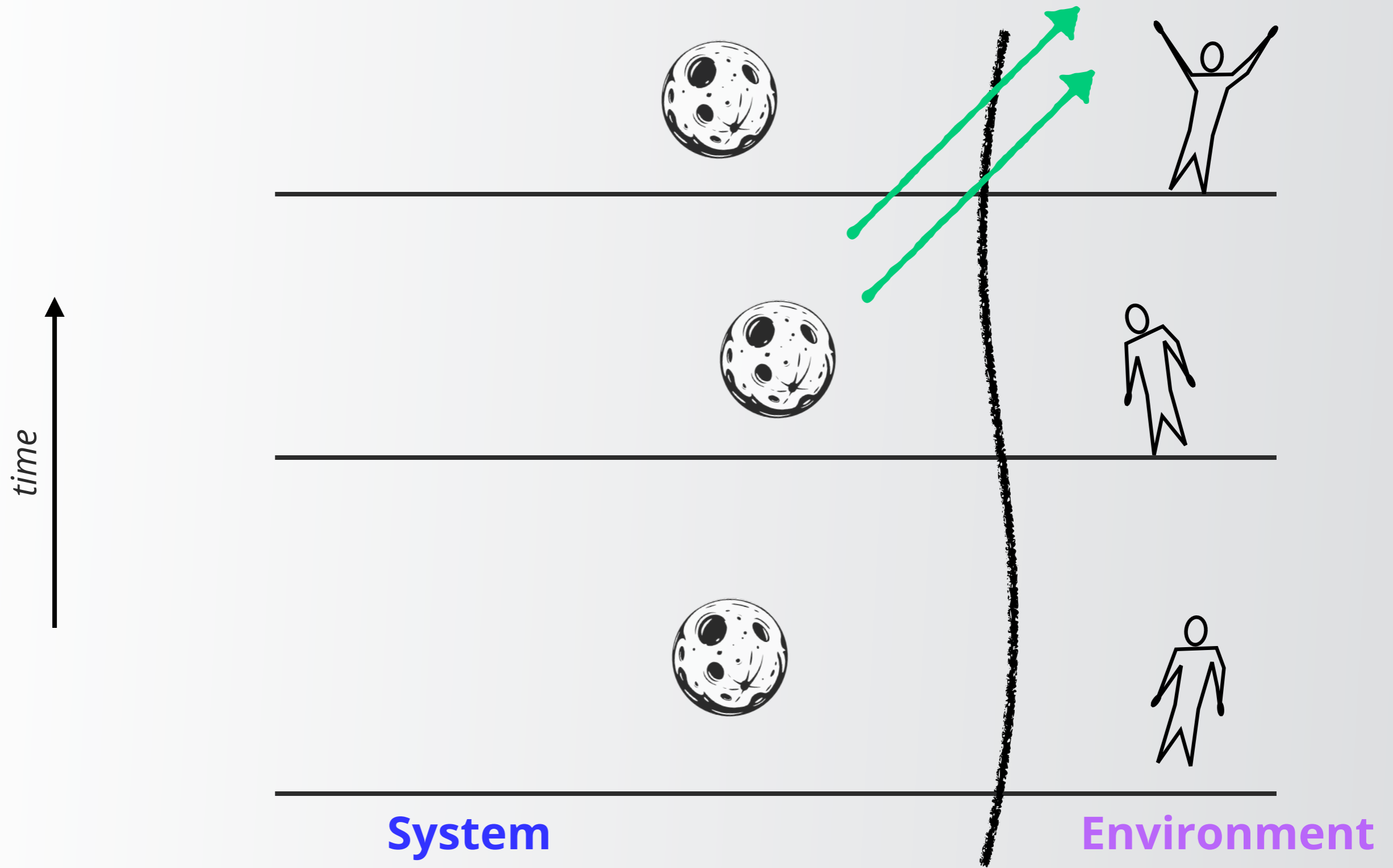
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Extended phase space

- ▶ add embedding functions (diffeos) to phase space

$$\vartheta_{ext} = \phi^* \vartheta + \phi^* (\Upsilon \lrcorner L).$$

- ▶ All diffeos become Hamiltonian

$$\{Q_\xi, Q_{\xi'}\}_{ext} = -Q_{[\xi, \xi']}.$$

That is great, but somewhat ...

- ▶ phase space changed by adding boundary modes x^μ .
- ▶ Hamiltonian vector field only acts upon newly added variables
- ▶ no relational change

$$\{Q_\xi, g_{ab}\}_{ext} = 0, \quad \{Q_\xi, x^\mu\}_{ext} = -\xi^\mu(x).$$

Leibniz bracket

- ▶ Leibniz bracket consists of Hamiltonian and dissipative part
- ▶ Leibnizian bracket is relational.



commons.wikimedia.org/wiki/File:Butterkeks.jpg

$$(\cdot, \cdot) = \{\cdot, \cdot\} + \{\cdot, \cdot\}.$$

Leibniz bracket

- ▶ Leibniz bracket consists of skew-symmetric and symmetric part

- ▶ used in **dissipative systems**

$$(H, H) = \textit{dissipation}.$$

- ▶ creates relational change

$$(Q_\xi, g_{ab}) = 2\nabla_{(a}\xi_{b)}, \quad (Q_\xi, x^\mu) = \xi^\mu(x).$$

