

Constraining Laws and Generating Mechanisms, Companions in Modeling

Laws fix what is possible. Mechanisms make it actual.

Dr Nanxin Wei nx.wei@hotmail.com

New Directions in Law-Based Explanations in the Sciences
London School of Economics · 14–15 September 2026

Where the laws went missing

Laws of nature have been the purview of fundamental physics and the metaphysics of science. Law-based explanation in special-science practice is barely explored.

Mechanisms have owned the special sciences since the New Mechanism movement — and have been liberalized considerably under pressure from critics:

dynamical systems (Fang 2021) · constraint and control (Bechtel & Richardson 2010) · structural and methodological readings (Jiang 2024; Ioannidis & Psillos 2022)

Restrictivist reply: pull mechanisms back to the machine metaphor. But the liberal views track how scientists actually talk.

Two dead ends

Quirky generalizations. Kleiber's law and its cousins: rare, contested, and peripheral to the inquiries that cite them.

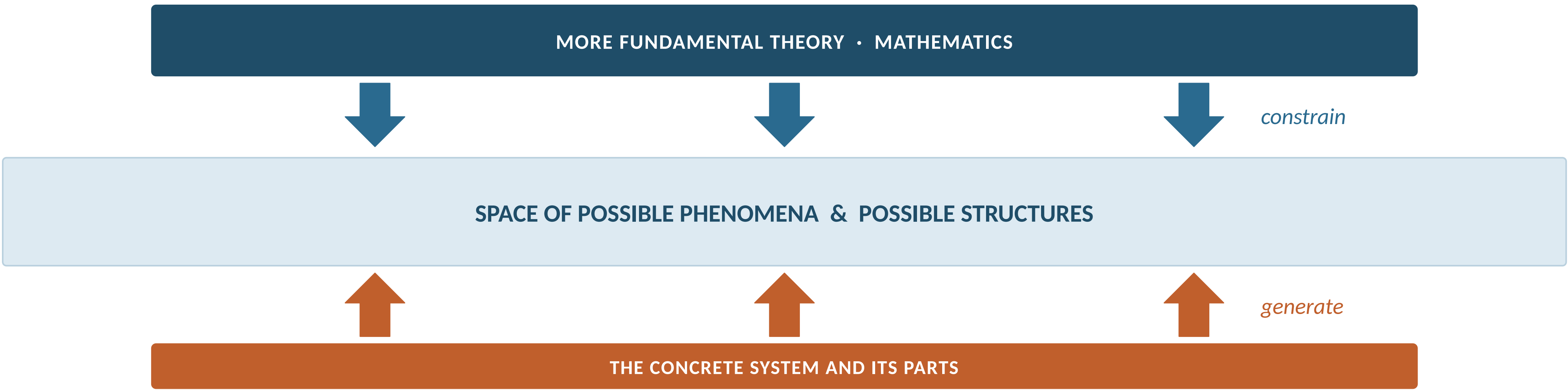
Ceteris paribus laws — a trilemma.

- Restrictive clauses** → collapse back into quirky generalizations
- Permissive clauses** → risk outright trivialization (Earman & Roberts 1999; Cartwright 2002)
- Practice-fitting reading** → contextualized generalizations governing phenomena production — indistinguishable from mechanisms (Woodward 2002)

The proposal: one target, two directions of explanation

LAWS

Top-down limits on what is possible, imposed by more fundamental theory or by mathematics — not DN subsumption. (Adlam 2022)

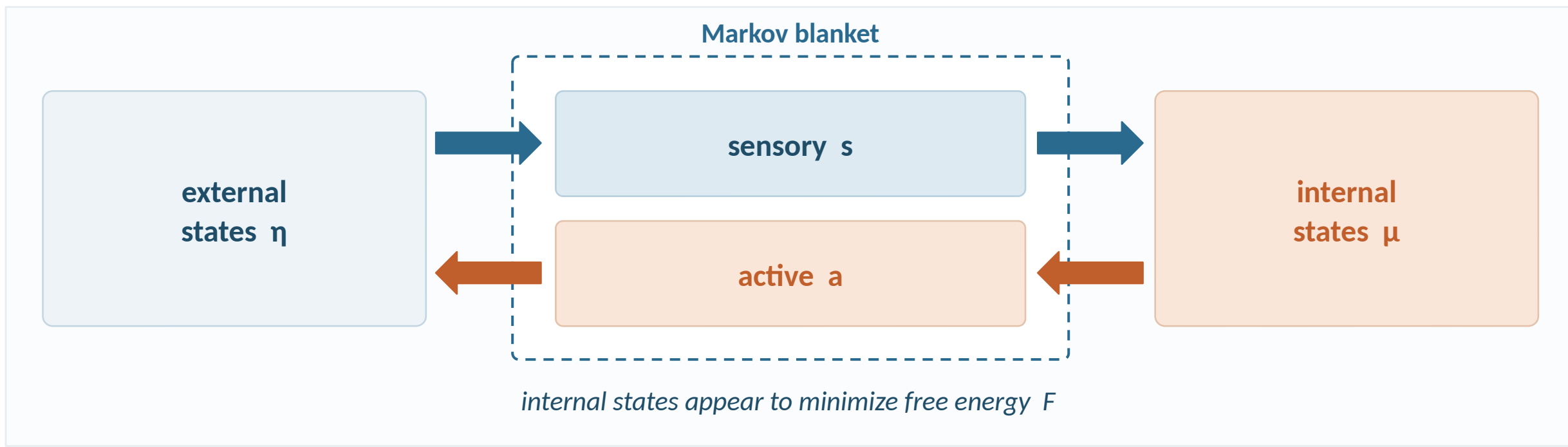


MECHANISMS

How this phenomenon is actually produced. Constraints internal to a mechanism play a different role: constitutive conditions. (Cartwright, Pemberton & Wieten 2020)

1 Free energy principle

Active inference in cognitive science

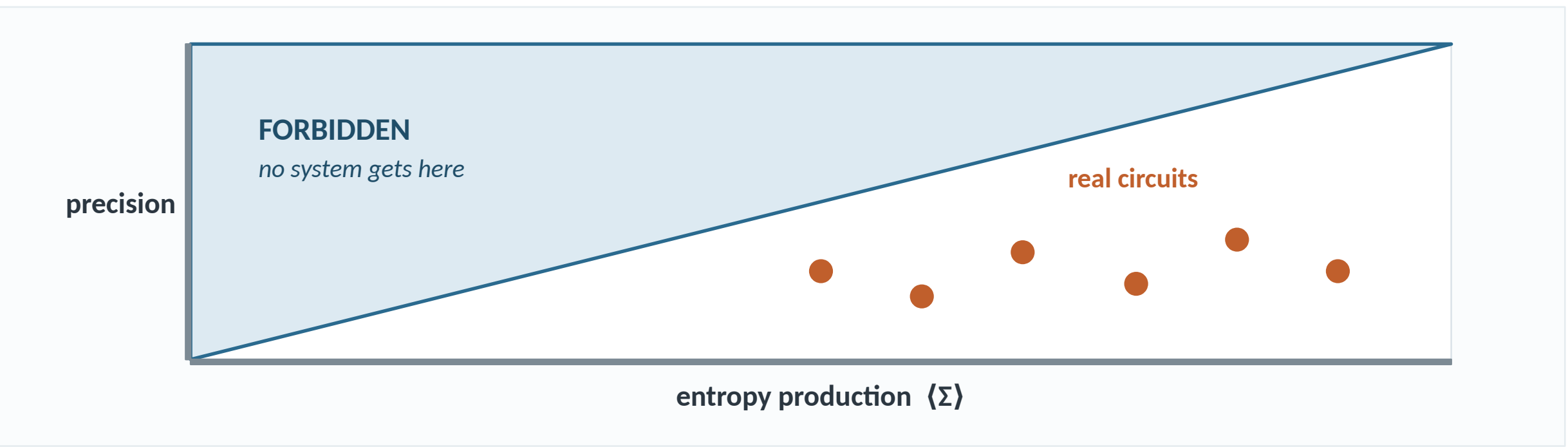


Redrawn after Friston (2013), fig. 1 — CC BY.

The principle builds no architecture. It fixes the envelope — which couplings could persist at all. Which circuitry a given organism deploys is the mechanist's question.

2 Stochastic thermodynamics

Precision and dissipation in biophysics

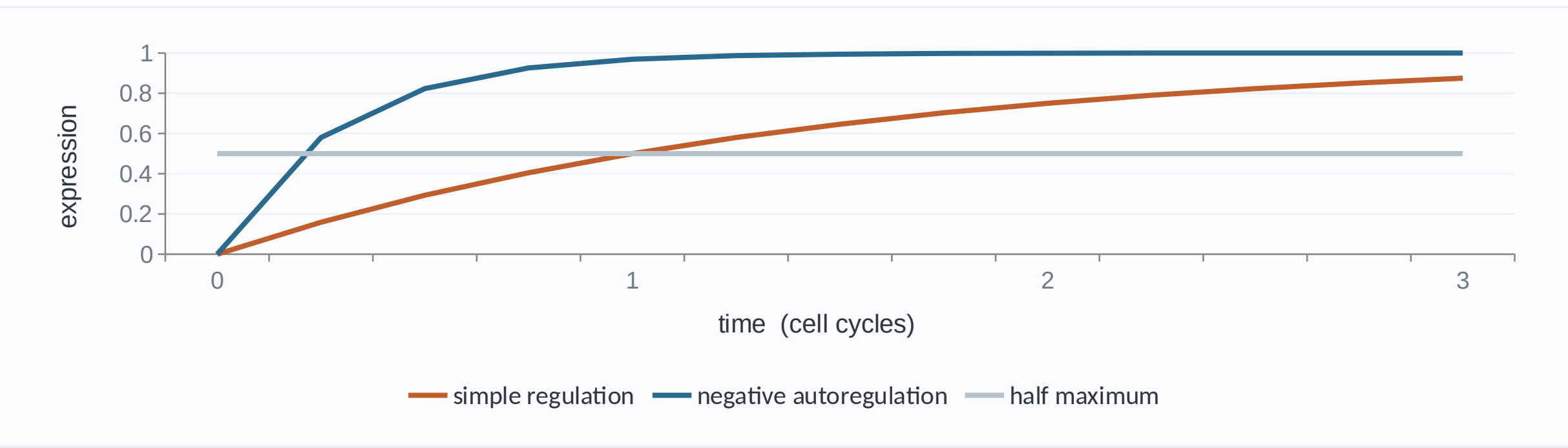


Bound: precision ≤ Σ / 2. After Barato & Seifert (2015).

Precision has a price. The bound holds for any molecular implementation whatever. The mechanism decides where under the line this pathway sits.

3 Design principles

Negative autoregulation in systems biology



Schematic; rise times after Rosenfeld, Elowitz & Alon (2002).

One principle, many circuits. Feedback buys speed and robustness in any medium — gene, metabolic or signalling. Each circuit shows how one of them does it.

Adlam, E. (2022). Laws of nature as constraints. *Foundations of Physics*, 52(1), 28.
Barato, A. C., & Seifert, U. (2015). Thermodynamic uncertainty relation for biomolecular processes. *Physical Review Letters*, 114, 158101.
Bechtel, W., & Richardson, R. C. (2010). *Discovering Complexity*. MIT Press.

Cartwright, N. (2002). In favor of laws that are not ceteris paribus after all. *Erkenntnis*, 57(3), 425–439.
Cartwright, N., Pemberton, J., & Wieten, S. (2020). Mechanisms, laws and explanation. *EJPS*, 10(3), 25.
Earman, J., & Roberts, J. (1999). Ceteris paribus, there is no problem of provisos. *Synthese*, 118(3), 439–478.

Fang, W. (2021). Toward Mechanism 2.1. *Philosophy of Science*, 88(5), 796–809.
Fang, W. (2024). Design principles as minimal models. *SHPS*, 105, 50–58.
Friston, K. (2013). Life as we know it. *Journal of the Royal Society Interface*, 10(86), 20130475.
Ioannidis, S., & Psillos, S. (2022). *Mechanisms in Science*. Cambridge University Press.

Jiang, Y. (2024). The metaphysics of mechanisms. *Synthese*, 204(1), 32.
Rosenfeld, N., Elowitz, M. B., & Alon, U. (2002). Negative autoregulation speeds the response times of transcription networks. *JMB*, 323(5), 785–793.
Woodward, J. (2002). There is no such thing as a ceteris paribus law. *Erkenntnis*, 57(3), 303–328.