# Fundamental Nomic Vagueness

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**Exact Law** A law $L$ is exact only if, for any world $w$, there is a determinate fact whether $w$ is compatible with $L$.

**Vague Law** A law $L$ is vague only if, for some world $w$, there fails to be a determinate fact whether $w$ is compatible with $L$.

Let's define the following for exact laws:

- A possible world $w$: a four-dimensional spacetime and its (material) contents
- The actual world $\alpha$: the actual spacetime and its contents
- $\Omega^T$: the set of possible worlds that satisfy the fundamental laws specified in theory $T$.
- $\Omega_\alpha$: the set of possible worlds that satisfy the actual fundamental laws obtaining in $\alpha$, i.e. the set of all physically / nomologically possible worlds.

Phenomenon of nomic vagueness:

- Vague laws (apparently) have borderline worlds and models.
- Vague laws (apparently) do not have well-defined extensions [in terms of sets of worlds].
- Vague laws are susceptible to sorites paradoxes.
- Vague laws (apparently) come with higher-order vagueness.

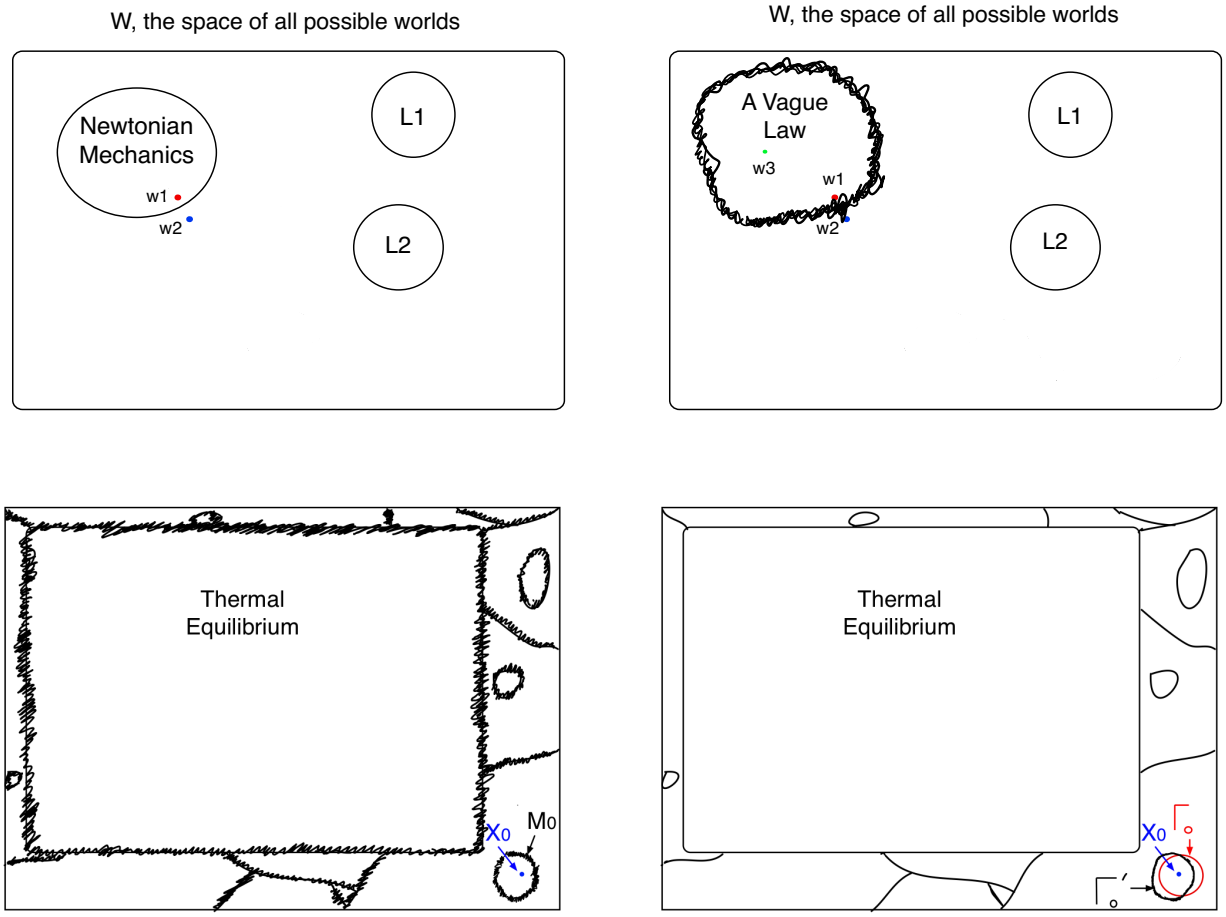
**Impossibility Conjecture** It is impossible to adequately express a vague fundamental law using the language of mathematics.

Case study: PH is a candidate for a fundamental law; it is vague because it is formulated in the language of macro-states and macro-variables.

**Super Weak Past Hypothesis (SWPH)** The universe initially was in a low-entropy state.

**Weak Past Hypothesis (WPH)** The universe initially had a particular low-entropy macrostate $M_0$, specified by the macro-variables $S_0, V_0, T_0, P_0$.

**Strong Past Hypothesis (SPH)** The initial microstate of the universe belongs to a precise set $\Gamma_0$, which is a particular low-volume sub-region of the universe's phase space.




SPH is arbitrary, in a very special way. Compare and contrast SPH with natural constants:

- Natural constants are also arbitrary—they have exact values even though they cannot be deduced from first principles.
- But natural constants have effects in the material world.
- Typically (in most worlds), any slight changes in the values of natural constants will be reflected in the material condition of the world, and they will change the nomological status of the world from possible to impossible (or some change wrt the probabilistic measure).
- Same for the exact forms of other fundamental laws.
- We call this property 'traceability.'

SPH is not microscopically traceable: Most "admissible" changes of the boundary of $\Gamma_0$ will not have any effects in the material world.

Paper versions: "Fundamental Nomic Vagueness," *The Philosophical Review*, 131(1), 2022; arXiv 2006.05298. "Welcome to the Fuzzy-Verse," *New Scientist*, Issue 3298, Sep 5th, 2020. Both can be accessed at: www.eddykemingchen.net