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Netherlands Organisation for Scientific Research

How fine-tuning for life is relevant to belief in a multiverse (and how not)

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The Physics of Fine-tuning, Crete, 20 June 2017

- ① The fine-tuning argument for the multiverse
- ② Inverse gambler's fallacy charge
- ③ Back to Dicke and Carter

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Parameters that appear fine-tuned for life:

- strength of gravity/electromagnetism
- strength of strong force/electromagnetism
- Q
- Λ
- ...

... and the laws themselves

- How come life exists despite the required fine-tuning? Can we explain?

Old debate – many reactions (*see my upcoming SEP article*).

General multiverse hypothesis: parameters vary across universes and/or long distances

- **Idea:** *If* there is a sufficiently varied multiverse, it is to be expected that at least one universe has the right parameters for life. That we find ourselves there is unsurprising.

Argument (by inference to the best explanation?): there is a multiverse.

Schematically:

- U : single-universe hypothesis
- M : multiverse hypothesis
- R : There is a universe with the right constants.
- B_0 : background knowledge

Plausibly:

- $P(R|U, B_0) \ll P(R|M, B_0)$.

Multiverse dramatically confirmed!

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Inverse gambler's fallacy charge (Hacking, 1987)

Full fine-tuning evidence is not R , but H !

- R : “There is a universe with the right constants.”
- H : “This universe *here* has the right constants.”

White, Sober, Landsman:

argument for multiverse breaks down if R is replaced by H .

My hunch on inverse gambler's fallacy charge:

- Background knowledge B_0 too unspecified and impoverished
- Impossible to definitely assess the argument

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Old finding (Weyl, Eddington, Dirac):

- many dimensionless cosmic numbers approximately coincide (see Bernard's talk).
- Dirac: these coincidences may hold everywhere and all the time, as a matter of principle.

Dicke (1961): No, we can only exist where the coincidences hold. Using our knowledge that we exist we could have predicted them. No need e.g. for assumption that gravity varies.

Here: existence of life used as part of background knowledge, not as data!

Let's include in our background knowledge the fact that we exist.

Possibly, a trade-off between U^{λ_0} and M :

- U^{λ_0} , unlike M makes precise prediction regarding λ .
- But M may be more simple and elegant.

Fine-tuning considerations impact: given our background knowledge that we exist, the advantage of U^{λ_0} is smaller than initially thought.

This may tilt the balance in favour of M .