

Integrity in Physics

Must the Methods change?

Julian Avila

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Universidad Distrital Francisco José de Caldas

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Debate for testability

Should Theoretical Physics Change?

- In 2014, some researchers argued that **elegant** and **explanatory** theories should be accepted **without experimental evidence**. [1]
- Does **beauty** in mathematics justify a theory's validity?
- How does this challenge the traditional scientific method?

- Karl Popper: **A scientific theory must be falsifiable.** [2]
- If a theory cannot be tested or disproven, **is it science?**

- Some theories remain **untestable**:
 - **String Theory** – No current way to verify extra dimensions.
 - **Many Worlds Interpretation** – No empirical evidence for alternate universes.
- Should physics include **metaphysical** theories? [1]

- The Standard Model originally **predicted massless neutrinos**.
- In 1998, experiments confirmed **neutrino oscillations** → neutrinos have mass.
- The theory was **modified**, not discarded. [3]

Post-Truth in Science

What is Post-Truth?

Oxford Dictionary defines **post-truth** as:

"Circumstances in which objective facts are less influential in shaping public opinion than appeals to emotion and personal belief." [4]

Is This Post-Truth?

- Some claim **String Theory** is valid due to its **mathematical elegance**, despite lacking experimental evidence.
- Does favoring aesthetics over **falsifiability** fit the definition of post-truth?
- Where should the boundary between **scientific rigor** and **theoretical speculation** be drawn?

What Is the Criterion?

- What makes a theory **elegant**?
- Should elegance alone justify scientific acceptance?
- How do we balance **beauty** and **empirical validation**?

How to improve

"In our view, the issue boils down to clarifying one question: what potential observational or experimental evidence is there that would persuade you that the theory is wrong and lead you to abandoning it? If there is none, it is not a scientific theory." [1]

If a theory cannot be falsified, is it scientific? How does this compare to astrology?

Philosophers and physicists must refine **the boundary** between science and speculation.

Bibliography

References

- [1] George Ellis and Joe Silk. **“Scientific method: Defend the integrity of physics”**. In: *Nature* 516.7531 (Dec. 2014), pp. 321–323. ISSN: 1476-4687. DOI: [10.1038/516321a](https://doi.org/10.1038/516321a).
- [2] Karl Raimund Popper. ***Logic of Scientific Discovery***. Taylor & Francis Group, 2005. ISBN: 9781134470020.
- [3] Gary Steigman. ***Primordial Nucleosynthesis: The Predicted and Observed Abundances and Their Consequences***. 2010. DOI: [10.48550/ARXIV.1008.4765](https://doi.org/10.48550/ARXIV.1008.4765).

- [4] Oxford. *Post-truth Adjective - Definition*. In: 2016. URL: <https://www.oxfordlearnersdictionaries.com/us/definition/english/post-truth> (visited on 03/27/2025).

Thank you for your attention!

Questions?